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NNSYLVANIA TREES

By

Joseph S. Illick,
Chief, Office of Research

BULLETIN 11
(Fourth Edition)

188458
18. 3. 24.

PENNSYLVANIA DEPARTMENT OF FORESTRY
Robert Y. Stuart, Commissioner

May, 1923.

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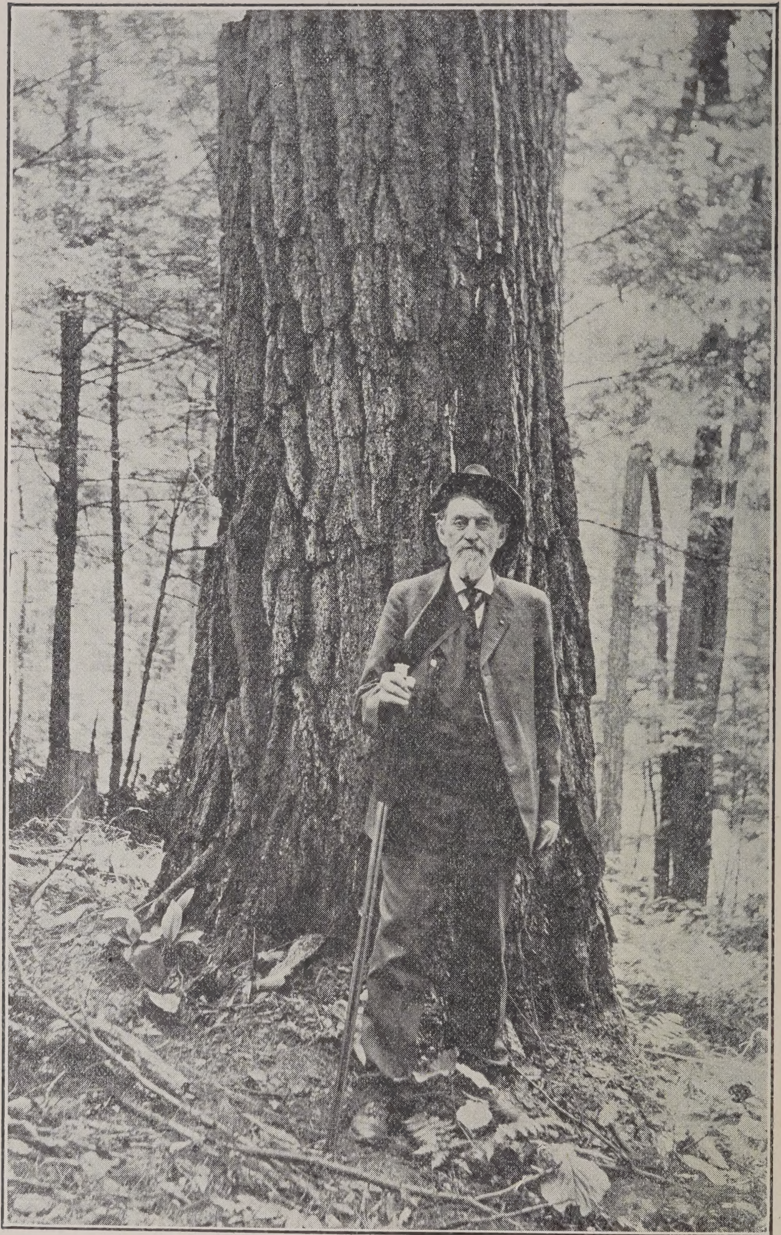

THE FATHER OF PENNSYLVANIA FORESTRY

PENNSYLVANIA DEPARTMENT OF FORESTRY

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PREFACE

Trees are more than mere green things. They have been man's friends ever since the human race began. In all ages and in every land they have been giving valuable service to man. They are among his best friends and greatest helpers. They produce many of our most useful and helpful gifts and grace the earth with their beauty. They are truly the wonderful handiwork of a beneficent God designed primarily for a life of service and to bring happiness and comforts to the people of the earth.

The world is full of instances of great men who loved great trees just as they would a human friend. The poet Whittier had a favorite tree. He called it his "inspiration tree." Henry Van Dyke has a favorite elm before his home. He calls it his "guardian tree." James Russell Lowell wrote that he confessed to so great a partiality for trees that he was tempted to respect a man in exact proportion to the man's respect for trees. Robert Louis Stevenson delighted in lying among the trees. He saw the beauty in them, admired their make-up, enjoyed their shade and shelter and felt their warmth and affection.

The delight and service the trees bring to us begins with the cradle and ends with the grave. They are such common place things that we are apt to over-look them and rarely do we give them full credit for the part they play in our everyday life.

There are about 278 different kinds of trees and shrubs native to Pennsylvania. Of this number 110 are usually classified as trees. The trees that are now native to this State are the same as were in the original forests, excepting one tree—white cedar—which has become extinct. It was formerly found in a few localities in the extreme southeastern part of the State.

While the trees in the forests of Pennsylvania remain the same as those that made up the original forests, yet one finds a marked difference in their abundance, age, size, form, quality, value and thriftiness.

The original forests of the State were large, dense and extremely productive. The present forests are small, open and very unproductive. Each generation of mankind has seen a smaller, more open, and less productive generation of forests. It is not a prophecy, but the statement of a bare fact, when we say that the source of our timber supply is becoming an acute and vital question. Fast-vanishing forests and ever-rising lumber prices are couriers of this fact. The Federal and some State Governments have already inaugurated policies to offset the present destructive tendency in our forests by starting constructive work.

To date no State has made a greater advance in forestry than Pennsylvania. She has, however, just started on this useful mission. The men who are directing her forest policies are endeavoring to lay a substantial foundation upon which a stable superstructure may be reared. In order to accomplish this it is necessary to have the cooperation of every citizen of the State, especially the woodland owners and managers.

Forestry needs the support of public sentiment. No substantial and permanent advance is insured until our citizens understand forestry and can distinguish the important from the inferior forest trees. It is hoped that the sphere of usefulness of this bulletin will not be limited to woodland owners and managers, but will extend to laymen, students, and botanists.

Part I is intended for the layman, the student of trees, and the beginner of forestry. A careful perusal of this part will enable one to comprehend Part II more fully.

Part II is essentially a manual of Pennsylvania trees. It comprises a discussion on the identification of trees and a description of families, genera, and species, with accompanying keys. The descriptive material and keys are the outgrowth of outline lecture notes prepared by the author and used for ten years in connection with a course in Dendrology given at the Pennsylvania State Forest Academy. The classroom work is supplemented by 15 years of field work in all parts of the State.

Each kind of tree is described under about 14 headings. No special originality is claimed for the characteristics given under these headings. It is natural to expect that the descriptive material should correspond with that found in other texts. The author is glad to acknowledge his indebtedness to the many books of reference which were frequently consulted to verify observations and to make the description clear and complete. The general range of the different species was drawn chiefly from Sargent's The Silva of North America and the Manual of the Trees of North America.

The data given under the heading Distribution in Pennsylvania was brought up-to-date in each of the four editions of Pennsylvania Trees. Since the appearance of the first edition in 1914 the author has personally collected much valuable information concerning the occurrence and distribution of the native trees. He visited many localities in the State and made a careful and critical study of the woody flora. Many correspondents also furnished the author with new stations at which rare and common trees occur. Dr. Otto Jennings, Curator of Botany, Carnegie Museum, Pittsburgh, Pa., supplied a large quantity of reliable data concerning the native trees, particularly those found in the western part of the State. His publication—A Botanical Survey of Presque Isle, Erie County, Pennsylvania—reprinted from the Annals of the Carnegie Museum, Vol. V., No. 2 and 3, 1909, supplied an authorative source of information concerning the occurrence of trees in the extreme northwestern part of the State. Since the first edition of Pennsylvania Trees appeared, new printed sources of material also became available, notable among which is Alfred Twining's Flora of Northeastern Pennsylvania, the most accurate and complete regional check list of its kind yet published in Pennsylvania.

The scientific names found in this bulletin are those used by the Department of Forestry, which follows the usage of the seventh edition of Gray's New Manual of Botany. Shifting of individual plates from their proper systematic position was necessary in a few cases in order to place two companion plates on opposite sides of the same sheet.

The photographic illustrations, 126 in number, are all original by the author, except Figs. 76 and 82 supplied by W. Gardiner Conklin; Fig. 26 supplied by Guy Carleton Hawkins; Figs. 27 and 54 supplied by B. J. Gutknecht.

The drawings were made by Miss Margaretta Washington, of Philadelphia, either from specimens supplied by the author or redrawn and adapted from Sargent's "The Silva of North America" by special permission of the publisher, Houghton Mifflin Company.

In making some of the drawings Schneider's "Dendrologische Winterstudien" and some of the reports of the Missouri Botanical Garden were consulted.

I take pleasure in giving sincere thanks to all others who have in any way assisted in this publication, especially the members of the Office of Research of the Department of Forestry and the students of the Pennsylvania State Forest Academy for their willing cooperation and helpful suggestions, and the Foresters of Pennsylvania for their assistance in collecting data concerning the distribution of trees in the State.

JOSEPH S. ILLICK.

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PART I

INTRODUCTORY

THE NORTH AMERICAN FOREST

There is good reason to believe that the major part of the habitable earth was originally wooded. North America is no exception to this. The original forest extended from the Atlantic coast west to about the ninetieth meridian, having only a few small openings like meadows and the tops of mountains. It also covered a large portion of the Rocky Mountain region and the Pacific slope. Estimates place the aggregate original area of the forests of North America at about 822,000,000 acres. that is an area obout 30 times the size of Pennsylvania. This original area has been so reduced that not more than 463,000,000 acres remain at the present time, or a little more than one-half of the original forest, a large portion of this acreage is in a very unproducitve condition.

The original forest of this country was vast in extent and composed of many and valuable species. The richness and variety of our tree growth may be in part attributed to the different climatic zones and variable physiographic features common to this country. So variable is our forest structure that at least five general forest regions may be recognized while often a local area may have its own peculiar forest type.

Many of the trees in the original forest attained a great age and enormous size. They yielded a vast amount of valuable products, a source of great wealth which has been supplying the raw material for one of our most important industries. Nature working through many centuries developed the original forest and gave it to us gratuitously. Man working through only a few centuries has established a great industry—the lumber industry; but on the other hand he has wastefully exploited our forests and left many of them in an unproductive condition. However, there was no alternative because the economic conditions then prevailing required, in part at least, this wasteful procedure.

FORESTS OF PENNSYLVANIA

The word Pennsylvania means Penn's woods. It derived its name from its early proprietor and the dense and extensive forest growth which covered the State. The original forest covered almost its entire area, which is usually given as 28,692,480 acres. Practically the entire State, with the exception of a few natural meadows and the tops of a few mountains, was covered with trees.

The original forest was composed of many and valuable species often occurring in dense stands. The richness of our forest flora is due to its favorable location with reference to climatic and physiographic factors. Pennsylvania is the meeting ground of many northern and southern species. In the western part of the State one finds outposts of species common to the Mississippi valley, while in the southeastern part some of the species of the coast region are found. Some of the northern species have their southern limits here, or else follow the mountains toward the south, while some of the southern species have their northern limits here, usually migrating northward through the valleys. The forests in the southeastern and the western parts of the State are composed almost entirely or hardwoods, while the central and the northern or mountainous parts are composed of a mixture of hardwoods and conifers. One may find the hardwoods by themselves and the conifers by themselves, or they may occur in mixture.

A few of our native species are very valuable, while others are less valuable and some mere forest weeds. The real value of a tree changes with the change of the general economic, particularly market, conditions. Within the last decade market prices of wood have risen so much that they have brought about a more intensive utilization of our forest products. Many trees formerly left standing in the forest are now utilized. A moment's reflection upon the present tendency in the utilization of the products of the various trees causes us to comprehend fully the truth of the statement that the despised trees of today will be prized tomorrow. The richness of the arborescent flora together with the great age and large size which some of the trees attained justifies the statement that Pennsylvania was at one time "one of the best timbered states of the Atlantic Coast."

Nature working through many centuries developed in this State a forest which was one of the most valuable of the many heritages with which her citizens have been blessed. If we could see maps showing the structure and distribution of the forests of Pennsylvania in the years 1600 and 1900, we would be astonished by the wonderful change that has taken place in a period that represents only a few generations of trees. Many were the agents which brought about this change, but it was left to man to play the leading role. Man working through a few centuries has removed the forest or abused it through fire and unregulated cutting. The establishment of pioneer homes, the opening of agricultural and grazing lands, the increase of population, the development of industrial enterprises, the

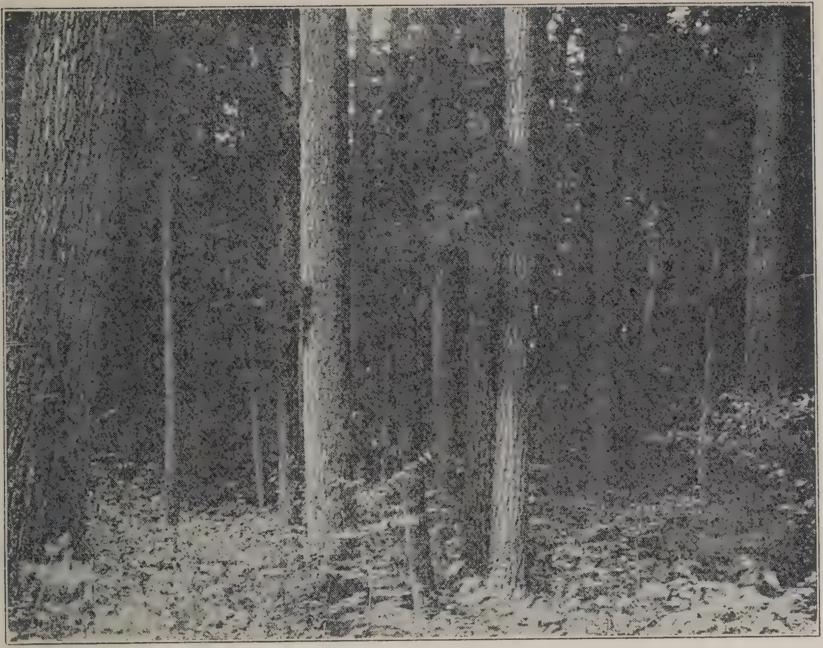

Fig. 1. STAND OF PENNSYLVANIA VIRGIN WHITE PINE
The kind of forest our forefathers found. A magnificent heritage

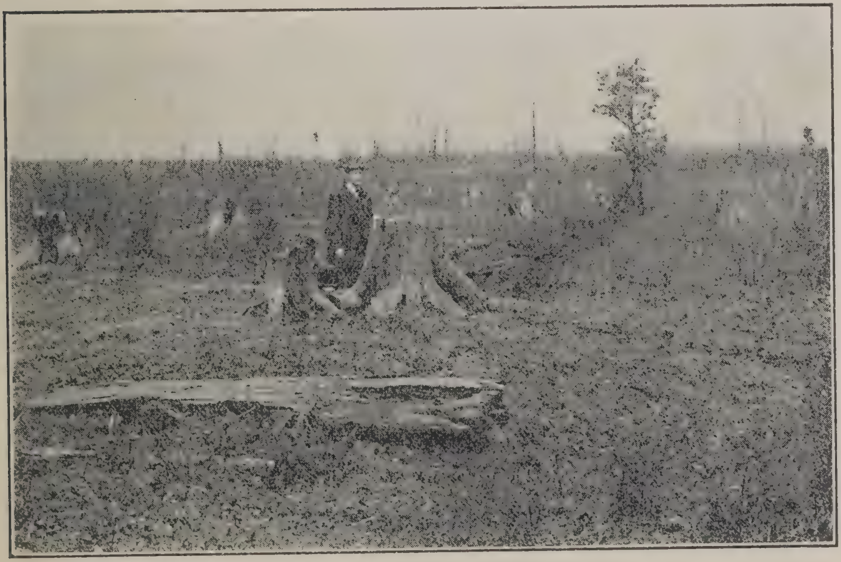

Fig. 2. RESULT OF EXTENSIVE FOREST EXPLOITATION
High stumps, and a thin scattered growth of inferior trees, is all that remains. The stumps indicate the density of the original stand, and the size of the trees

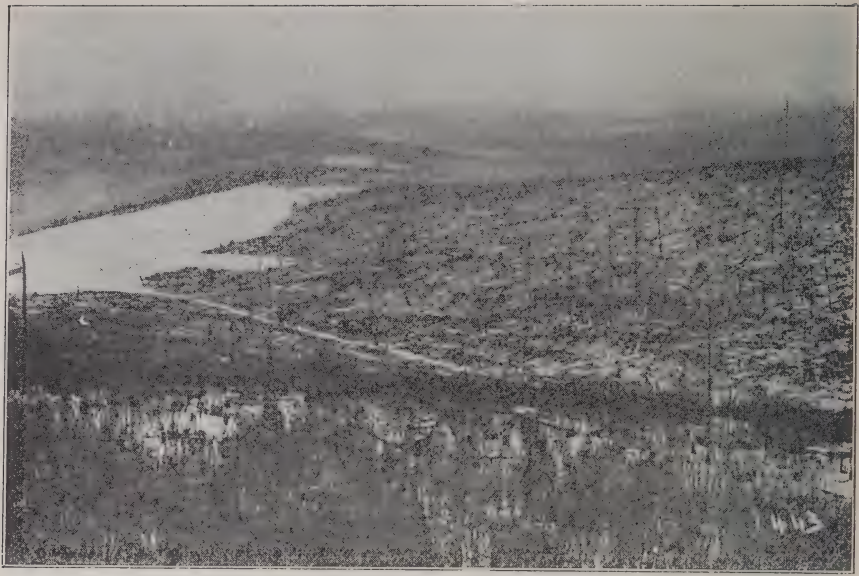

Fig. 3. ACRES OF DESOLATION

More than 5,000,000 acres of such barren land are found in Pennsylvania. Much valuable timber was lost through reckless and premature exploitation of the original forest

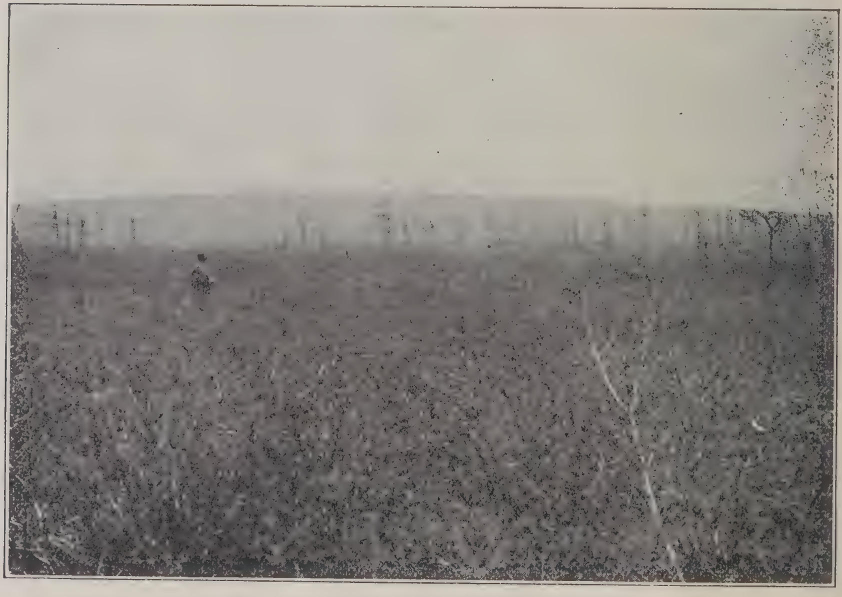

Fig 4. ACRES OF SCRUB OAK

Scrub Oak has no timber value. Large areas in our forests contain many weed species which often prevent other valuable trees from establishing themselves destructive work of lumbermen, and the advent of forestry present a picture of change and progress, which enables us in part to comprehend the important role that man played in transforming the original forest into the present forest.

Pennsylvania originally contained large, dense, and extremely productive forests. The large have become small, the dense have become open, the productive have become unproductive. Each generation of mankind has seen a smaller, more open and less productive generation of forests. The march of forest destruction has been rapid and severe and yet inevitable on account of existing economic conditions. While originally almost the total area of the State was covered with tree-growth, today only 45 per cent is covered by woody growth and over 5,000,000 acres of this is barren or unproductive, while many more acres are poorly stocked with trees. Most of our woodland areas are at present in a very unproductive, unsantiary, unattractive, and unregulated condition.

Economic conditions have changed and the old order of things need not continue. We must substitute conservative lumbering for the wasteful exploitation of the past. We must do constructive work in our forests now to recompense for the destructive work carried on during the last few centuries. We should aim to show our social and civic worth by handing down to future generations a heritage equivalent to that which we received from our forefathers. In order to do proper constructive work it is necessary to establish a goal or an ideal and develop proper methods by which it can be reached or at least approximated. We need not be entirely original in this work since a few countries like Germany, Switzerland, and France have already in more than a century of experience laid the foundation for conservative and constructive forestry. We can learn much from these countries. A visit to their carefully managed forests together with a general survey of the methods which they use in managing them will be helpful in formulating plans for our Ideal or Normal Forest. We may not be able to adopt their methods but we can adapt them. The question at once presents itself: How can we improve our woodlands so that they will approach the well-managed forests of Germany, or the ideal or normal goal which we are setting up for them? The following answers suggest themselves:

1. By giving adequate protection. Fire is the chief agency against which our forests need protection.
2. By procuring wise taxation.
3. By prohibiting unregulated cutting.
4. By securing quick reproduction after the removal of the timber.
5. By establishing a complete stock of valuable trees on all forest soils.

6. By removing undesirable trees and replacing them with a better class of trees.
7. By establishing a proper proportion and a suitable distribution of age classes.
8. By making every part of the forest accessible by means of roads, lanes, trails, paths, compartment lines, etc.
9. By making improvement cuttings.
10. By dividing the forest into working units (compartments) just as a farmer divides his farm into fields and the fields into patches.

THE FORESTS AND FORESTRY

The original forest was so modified by the activity of man, or man working conjointly with natural agencies, that the sources of our future wood supply became a question of great importance. A general survey of the field showed that we were consuming wood faster than we were producing it. This unbalanced economics condition due to the unregulated condition of our forest gave birth to the subject of forestry. Man's attitude towards the forest showed that he was a disturbing agent. Without him the forest of Pennsylvania would have remained practically undisturbed, indefinitely. Hence it might follow that the forest thrives best where there are no people, and consequently no forestry. Further, one often hears the statement: Formerly we had no forestry and plenty of wood; now we have forestry but no wood. This statement does not prove that forestry is to be blamed for a deficiency in our wood supply, but it does prove that forestry is the child of necessity. This child of necessity, which is at present just in its formative period, could never have been born if we had not been compelled to see that our timber resources were rapidly decreasing.

The word forestry to many may be new. The most enlightened may have a rather vague conception of its exact scope. It is often identified with the planting of individual trees, landscape work, and tree surgery. Forestry should be regarded as the rational treatment of our woodlands for their products. The kind of treatment depends largely upon the desire of the owner. The ownership may be private or there may be a public owner, as a municipality, a state, or a nation. The desire of the owner may be to supply wood material, to retain or establish a protective cover, to furnish recreation grounds, or to maintain a game cover. The forests which are managed for the purpose of producing a supply of woody material are known as *production forests or supply forests,* while those which are retained or often established as a protective cover are known as

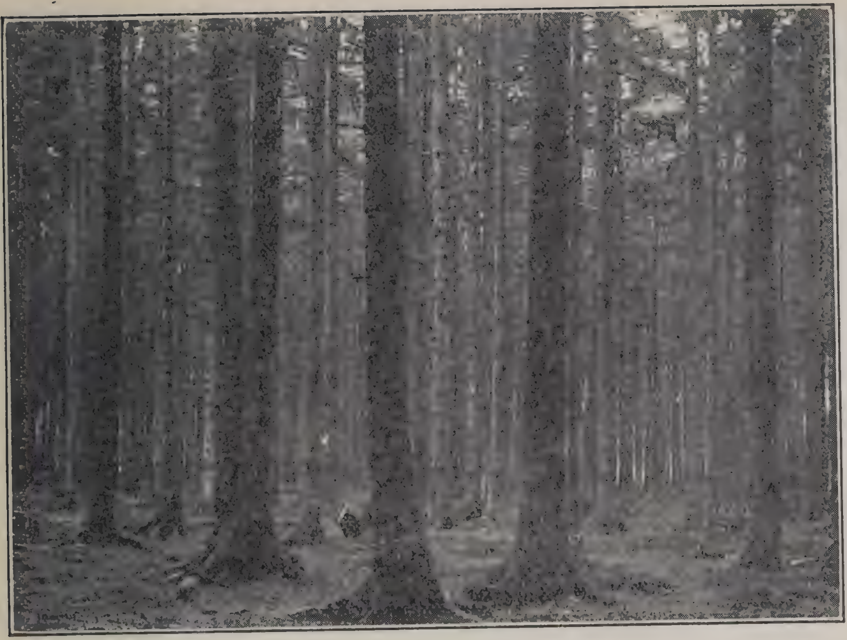

Fig. 5. DENSE STAND OF NORWAY SPRUCE, GERMANY

The kind of forests we hope to develop. Norway Spruce is a valuable and a beautiful tree

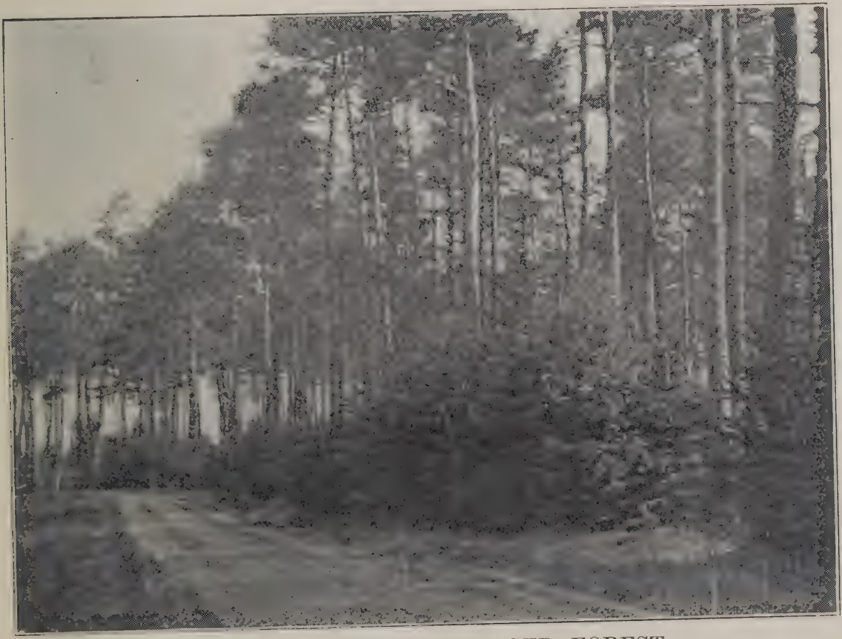

Fig. 6. CAREFULLY MANAGED FOREST

Attractive, sanitary, productive, and organized. Good roads ramify through all its parts

Fig. 7. TREES FRAME THE HOME PICTURE AND PRODUCE A RESTFUL FEELING AND A SPIRIT OF HOMELINESS

Fig. 8. TREES BEAUTIFY THE HIGHWAYS, BYWAYS, STREETS, AND PUBLIC PARKS

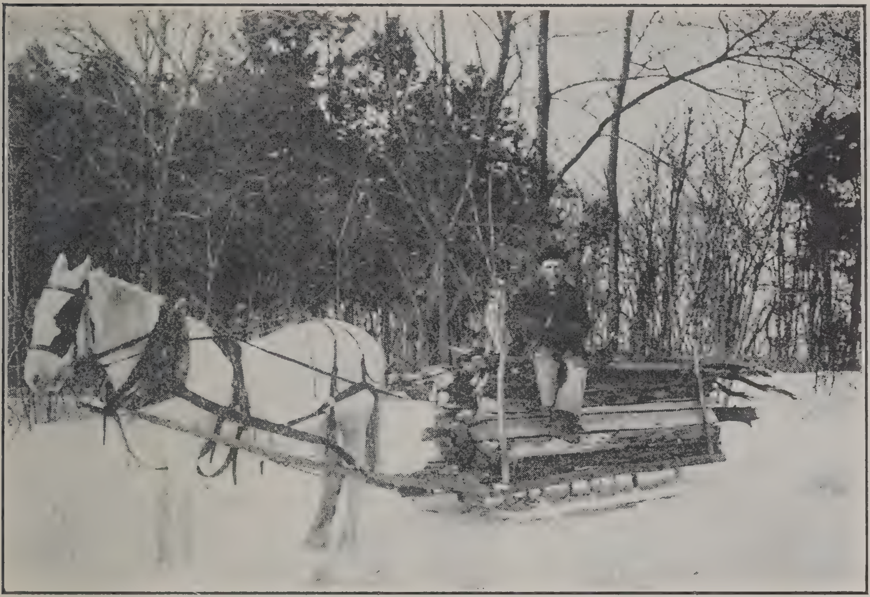

Fig. 9. HAULING DEAD FUELWOOD
The removal of dead and damaged material improves the composition of the forest

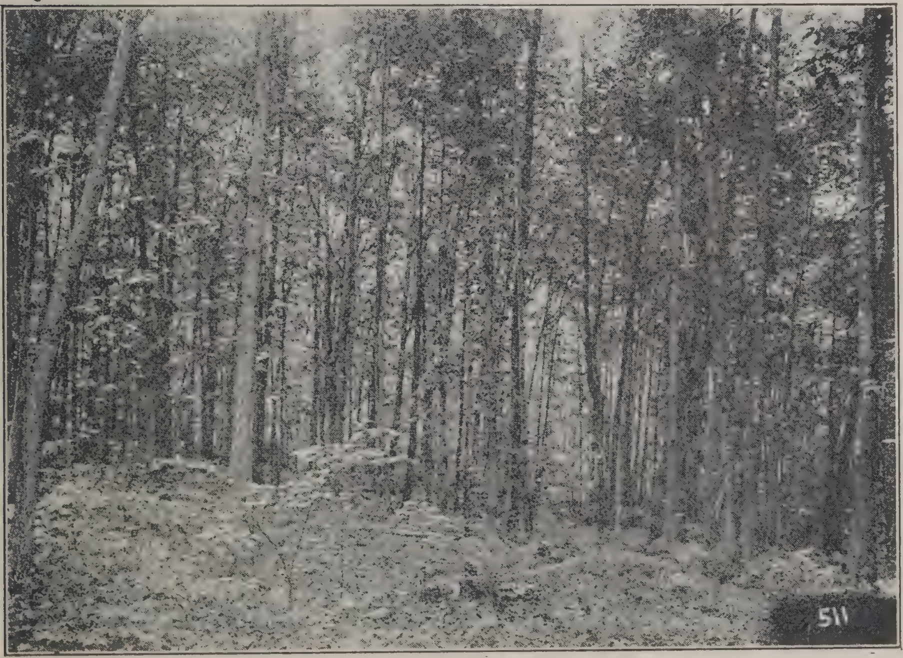

Fig. 10. THE RESULT OF SELLING DEAD WOOD
Proper use of forest products results in attractive, sanitary, and productive stands of timber

protection forests. Protection forests aim to prevent calamities like destructive floods, excessive erosion, sand shifts, and snow shifts. Forests managed primarily to enchance the beauty of the forests and to furnish recreation grounds for the public may be known as *park forests.* Park forests should always be accessible to the public. Such outing grounds will not only be a means of preventing many of our diseases but also help to restore to health those who are already afflicted. Forests managed by the owner primarily to enjoy sport are known as *luxury forests.*

Forestry aims to have man improve upon nature's ways of doing things. Nature grew forests upon areas regardless of the fitness of these areas to other more profitable pursuits. Both the thin, relatively sterile soils of the mountains and the deep, fertile soils of the valleys were covered with forests. The latter are far more valuable for the production of food material than for the production of wood material. Forestry aims to develop forests on forest soil. It does not attempt to encroach on agricultural soil but aims first to classify the land into ploughland and woodland; and then to treat the woodland areas so that they will yield the largest quantity of high class wood material in the shortest time at the least expense of time and money and to give to mankind as many other natural blessings as possible. The economic point of view should always be kept paramount. The forester's forest should supply more fully the present and prospective human wants than they can be supplied by depending upon nature's uncertain and unregulated performances.

THE STRUCTURE OF THE FOREST

Every region and, often, even every small locality has its peculiar kind of forest. The composition of the forests along streams, on slopes, and upon mountain tops usually shows great differences. The climatic factors and physiographic features of a region influence the composition of the forest very much. The more varied the factors of the habitat are, the more varied the composition of the forest usually is. Upon the same mountain slope one can often find three and sometimes more zones of trees. Each zone is composed of different kinds of trees or groups of trees, which groups vary not only in composition, but also in form, density, and thriftiness.

The forester seldom considers trees raised in isolated positions, but rather concerns himself with trees raised in masses or stands. Such masses of trees, irrespective of their kind, size, density, form, number, or value are known as woodlands. Woodlands may be composed of a single species or of two or more species. If one species composes ninety per cent or more of the total stand it is known as a *pure stand* and if the stand is composed of two or more species none of which forms ninety per cent of the total stand it is known as a *mixed stand.* Woodlands are rarely quite pure. A slight admixture of some species is usually present. The forests of Pennsylvania are decidedly mixed in their composition. The conifers are found oftener in pure stands than the broad-leaved species. Since the forests of this State are composed largely of hardwood species it is rather unusual to find pure stands. Occasionally one may find small pure stands of such trees as Pitch Pine, White Pine, or Red Cedar.

About 125 species of trees are native to the State of Pennsylvania but not more than 25 species are of sufficient importance to deserve to be developed on an extensive scale in our future forests. A large proportion of our native trees is found as undergrowth. They form dense and sometimes almost impenetrable thickets. This dense and complex structure of our underwood aids considerably in increasing the number of participants in our forests. Dense and tall undergrowth tends to protect the soil from erosion, to conserve the fertility of the soil, and to afford shelter to birds which prey upon the insect enemies of the forest; but it may also impede the utilization of forest products and make the tending of the forest more difficult.

The tendency of forestry is to eliminate the undesirable trees. We should eliminate cautiously since the despised trees of today may be prized tomorrow. If this process of elimination is developed on an intensive scale, it means a reduction in the number of species and, in extreme cases, leaves only one species, i. e. a pure stand. This is especially true where a forester aims to establish a stand by artificial seeding or planting. He is apt to choose a tree which he thinks will give the highest returns. If he selects the proper species and it is not injured during its development he may possibly obtain satisfactory results.

Before establishing stands one should consider the subjoined advantages of pure and mixed stands.

The principal advantages of pure stands are:—

1. Pure stands are easier and cheaper to establish.
2. Pure stands are easier to tend and manage.

The principal advantages of mixed stands are:—

1. Mixed stands utilize the available plant food in the soil and air more fully. Close utilization of the factors of the habitat and keen competition by every forest tree upon its neighbor are requisites for optimum quantity and quality production.

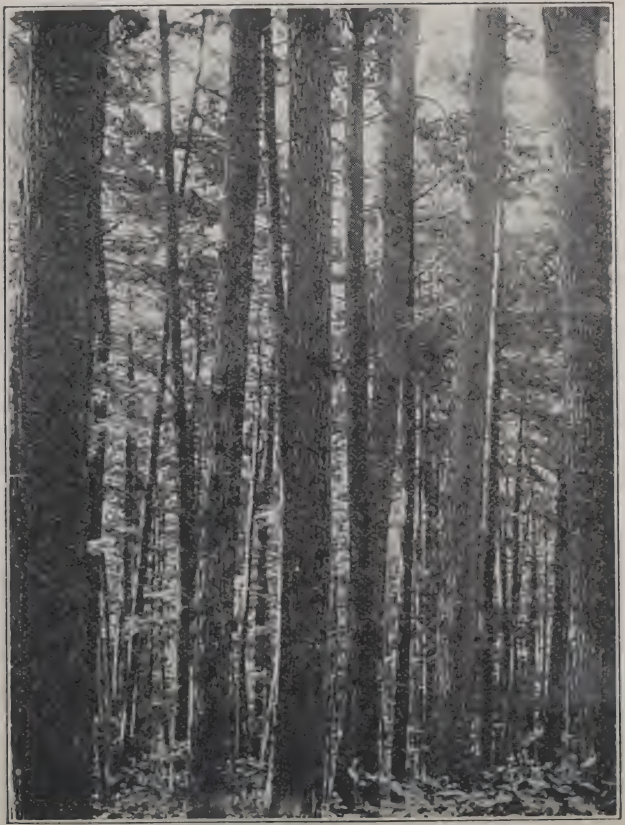

Fig. 11. PURE STAND OF WHITE PINE

A dense stand with clean stems and little taper. All age-classes represented

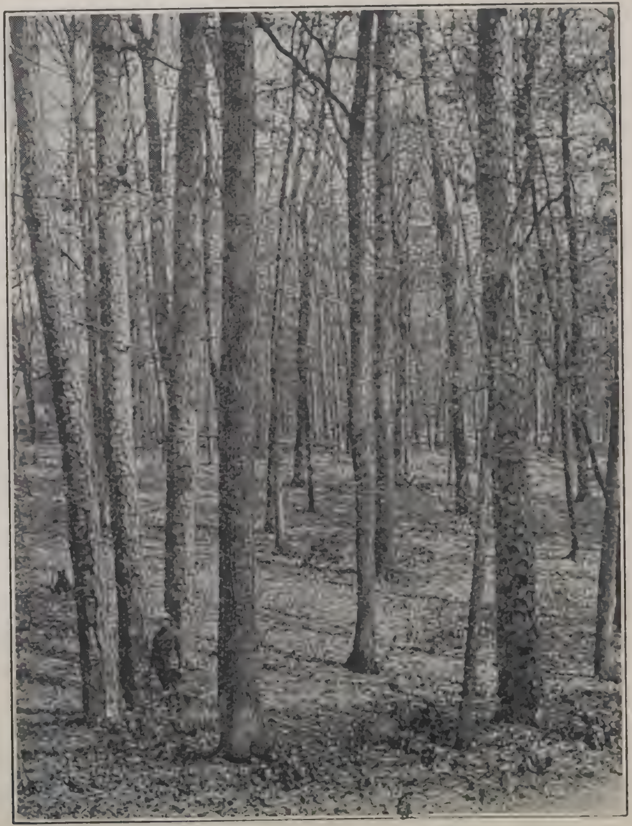

Fig. 12. MIXED STAND OF OAK, HICKORY AND YELLOW PINE

Will yield about 18,000 board feet per acre. Such stands are rare today. Franklin county, Pennsylvania

2. The forester can meet the demands of the market better with a few species than with one species.
3. A larger number of trees per unit of area is usually found in a mixed stand than in a pure stand.
4. Most trees are less subject to damage by wind, frost, fire, fungi, and insects, in mixture than when grown pure.
5. Trees usually develop a better form if mixed properly than if grown pure.
6. Mixed stands are more attractive than pure stands.

A great many pure stands may be seen in the forests of continental Europe. Some of them were established over 100 years ago and are now ready to be cut. After more than a century of experience in planting, foresters are abandoning the policy of establishing pure stands and are advocating mixed forests. Mixed forests may consist of a mixture by single trees or of a mixture by groups. The mixture may be temporary or permanent, even-aged or uneven-aged.

We should aim to improve the composition of our forests by reducing the percentage of inferior species and increasing that of the more valuable ones. The present cover types which consist of many despised, some neutral, and a few prized species, should be transformed into the future management types which will be characterized by a simpler but better composition.

FOREST TYPES IN PENNSYLVANIA

The wide range of altitude, latitude, topography and soil conditions that occur within Pennsylvania produced and now maintain a large and variable woody flora. Many northern and southern trees meet within the limits of the State. The former follow the mountains towards the South and the latter extend northward into the valleys.

The forest structure of Pennsylvania varies widely from place to place. A systematic description of this variable forest make-up requires that the aggregate forest area be divided into suitable units. Present usage suggests that these units be termed *Forest Types.* Within Pennsylvania the following major forest types may be found:

1. Spruce-Fir Type (Northern Swamp Type)
2. Beech-Birch-Maple Type (Mixed Northern Hardwood Type)
3. White Pine-Hemlock Type
4. Aspen-Fire Cherry Type
5. Chestnut-Rock Oak-Pitch Pine Type

6. Scrub Oak Type
7. Oak-Hickory Type
8. River Birch-Swamp Maple Type (River and Swamp Hardwood Type)
9. Sweet Gum-Willow Oak Type.

The Spruce-Fir (Northern Swamp) Forest Type is not common in any part of Pennsylvania. It occurs locally in the northeastern and northern parts of the State. Additional sprinklings occur elsewhere in the State; for example, in the Bear Meadows in Centre County and Pymatuning Swamp in Crawford County. This forest type also occurs in the mountains south of Pennsylvania but does not appear in the southern part of this State. Mountain Ash, which is a member of this type in the northern part of the State, however, is found on the mountain slopes of Bedford County.

The principal members of this type are: Red Spruce, Black Spruce, Balsam Fir, American Larch, and Mountain Ash. In addition to these five principal indicator trees, the following trees and shrubs are frequently associated with them: American Yew, Red-berried Elder, Hobble Bush, Small Cranberry, Mountain Holly, Labrador Tea, Soft Maple, Black Ash and Yellow Birch.

The Beech-Birch-Maple Type is found chiefly in the northern part of the State with a number of local southward extensions in the mountain region. The principal members of this type are: Beech, Yellow Birch and Sugar Maple. In addition to these three principal members there often occurs with them sprinklings of White Pine, Hemlock, Wild Black Cherry, Ironwood, Red Maple, Striped Maple, Mountain Maple, White Ash and Paper Birch.

Yellow Birch, Beech and Sugar Maple comprise about 60 per cent of the total stand, while the other hardwoods constitute 30 per cent and the conifers as a rule do not exceed 10 percent. The Beech-Birch-Maple Type is one of the most important forest types of the State, for it covers a considerable acreage in the northern part of the State which is primarily a forest region.

The White Pine-Hemlock Type occurs in the northern central part of the State and extends southward along the Alleghenies and other nearby mountain ranges. The limits of this type are not clearly demarcated, for on the north this type mixes with the Beech-Birch-Maple Type and on the south it blends with the southern hardwoods.

The principal members of the White Pine-Hemlock forest type are: White Pine, Hemlock, Red Maple, Gray Birch, Striped Maple, Mountain Ash, Witch-hazel and Basswood. In addition to these principal members there are also found Yellow Birch, Beech, Sugar Maple, Blue Beech, Wild Black Cherry, White Ash, Cucumber, Yellow Poplar and Sycamore.

Locally a pure White Pine-Hemlock type may be present, while in other places a pure Hemlock type occurs. Some Foresters subdivide this type into two distinct types, but for the present it seems recommendable to recognize only one general White Pine-Hemlock type and as rapidly as a more intensive refinement becomes necessary additional types or sub-types may be designated.

The Aspen-Fire Cherry Type is confined chiefly to the northern part of the State where it follows after fires and lumbering of the Beech-Birch-Maple and the White Pine-Hemlock types. It is a temporary forest type, and shows no particular preference for soils or sites. It springs up rapidly on burned-over areas with bare mineral soil.

The principal members of this type are: Fire or Bird Cherry, Trembling Aspen and Large Toothed Aspen. With the trees the following plants are frequently associated: Bracken Fern, Sweet Fern, Blackberry, Wintergreen, Willows and a moderate sprinkling of Black Locust, Red Maple, Sugar Maple, Beech, Red Pine, and White Pine may occur locally.

Since this is a temporary type its composition varies with the age of the trees. Towards the end of the type's development the distinctive features of the type will be displaced by the permanent type that is replacing it. In most places the type begins to disappear rapidly when the trees are about 25 years old. It is followed by more valuable types, such as Beech-Birch-Maple and White Pine-Hemlock.

The Chestnut-Rock Oak-Pitch Pine Type is very complex and widely distributed in Pennsylvania. It occurs on most of the mountain slopes in the eastern, southern, south central and north central parts of the State. The principal members of this type are: Chestnut, Rock Oak and Pitch Pine. Associated with them one frequently finds Black Birch, Mountain Laurel, Maple, Mountain Pine at higher elevations and Jersey or Scrub Pine on lower elevations. In the past some Foresters have recognized a distinct Chestnut type, but this is now rapidly disappearing, for the chestnut is doomed. Locally it may seem desirable to have a distinct Pitch Pine type, but generally it is not necessary to make such a detailed refinement.

The Scrub Oak Type is common on the mountain slopes of the southern central and northeastern parts of Pennsylvania. It is the prevailing temporary forest type in the anthracite coal region, parts of the bituminous coal region and other adjoining forest areas. The conversion of this inferior type to stands of valuable trees is one of the biggest problems that confronts Pennsylvania forestry today.

The principal members of the Scrub Oak type are: Scrub Oak, Chestnut Oak, Rock Oak, Pitch Pine, Bracken Fern, Sweet Fern, Huckleberries and Blueberries. Scrub Oak is the principal tree in this type. Some areas are occupied by this inferior forest tree to the exclusion of all other trees. The Scrub Oak type usually follows after forest fires that occur on land covered with the Chestnut-Rock Oak-Pitch Pine type. The Aspens also occur locally with the Scrub Oak. Pitch Pine, the most fire resistant tree native to Pennsylvania, often forms an open shelter growth over the Scrub Oak.

The Oak-Hickory Type comprises more different kinds of trees than any other forest type found in Pennsylvania. It prevails in the woodlots in the agricultural valleys and on the bordering foothills. It is common in the Delaware, Schuylkill, Susquehanna, Cumberland, Chester, Lancaster, Lebanon and Buffalo valleys and it is the prevailing forest type in the western part of the State. It is very irregular in outline. Usually one finds it at lower elevations but some of its arm-like extensions reach far into the mountain valleys. The principal members of this forest type are: White Oak, Black Oak, Red Oak, ScarletOak, Bur Oak, Shagbark Hickory, Mockernut Hickory, Pignut Hickory, Black Walnut, Red Mulberry, Sassafras, Hackberry and Red Cedar.

The River and Swamp Hardwood Type occurs along all the principal rivers of the State and their main tributaries. The principal members of this type are Silver Maple, Ash-leaved Maple, River Birch, Walnut, White Oak, Black Ash, Swamp Hickory and Sycamore. At higher elevations Red Maple, Black Gum and the Tulip Tree may also be found in this type and at lower elevations the Red Osier Dogwood, Buttonwood and Willows are associated with the tree members of the type.

The Sweet Gum-Willow Oak Forest Type is found only in the extreme southeastern part of Pennsylvania. Outposts of it are found along the Susquehanna River and a few important tributaries of the Potomac River. The principal members of this type are: Sweet Gum, Willow Oak, Christmas Holly and Persimmon. In addition to these four trees, the Hop Tree, Fringe Tree, Short-leaved Pine and Laurel Magnolia sometimes occur in this type.

The nine forest types which have been described are sufficient to prepare an accurate forest description of Pennsylvania. They will be of great help in classifying the forest structure of the State and in working out practical methods of handling the forest. We must learn to know our trees better and understand the forest structure more fully in order that practical forestry methods can be applied successfully.

THE ESTABLISHMENT OF THE FOREST

As rapidly as the mature forests on absolute forest soil are removed they should be succeeded by young forests. These new forests which follow in the wake of those removed may be established by one

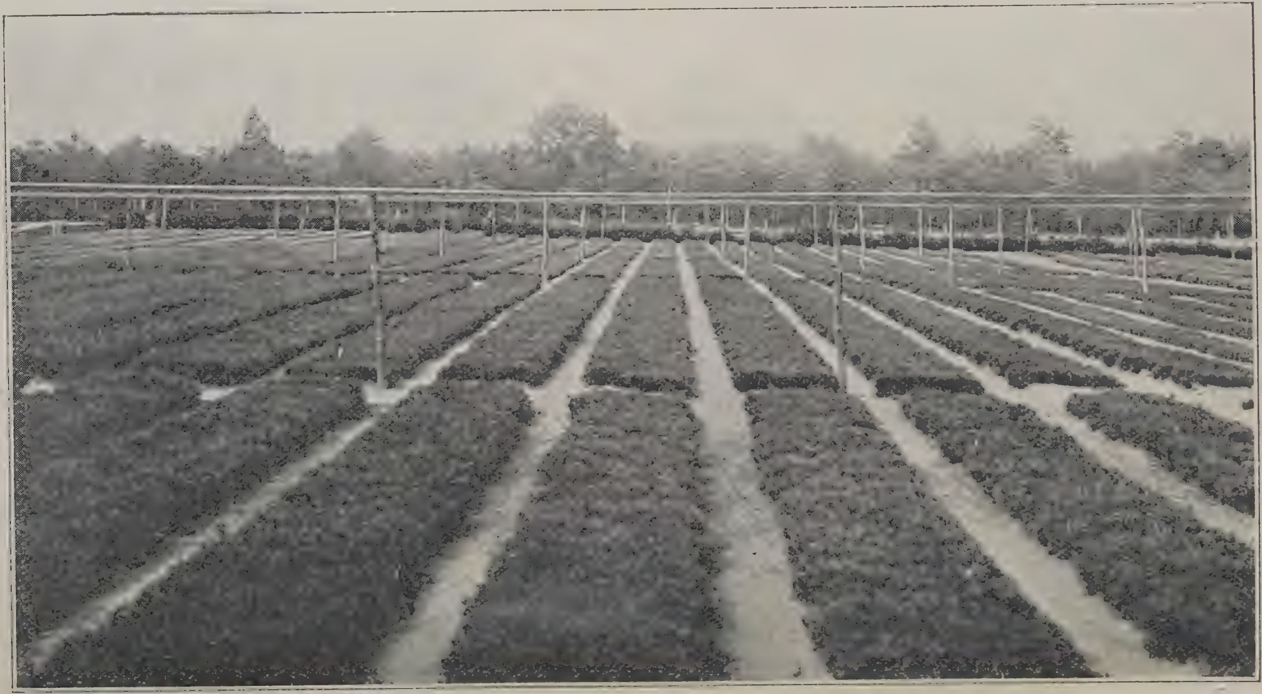

Fig. 13. A FOREST TREE NURSERY AT CLEARFIELD.

It has an annual output of 4,000,000 trees. By 1925 the annual production of the nurseries operated by the Pennsylvania Department of Forestry will be 20,000,000 seedlings and transplants.

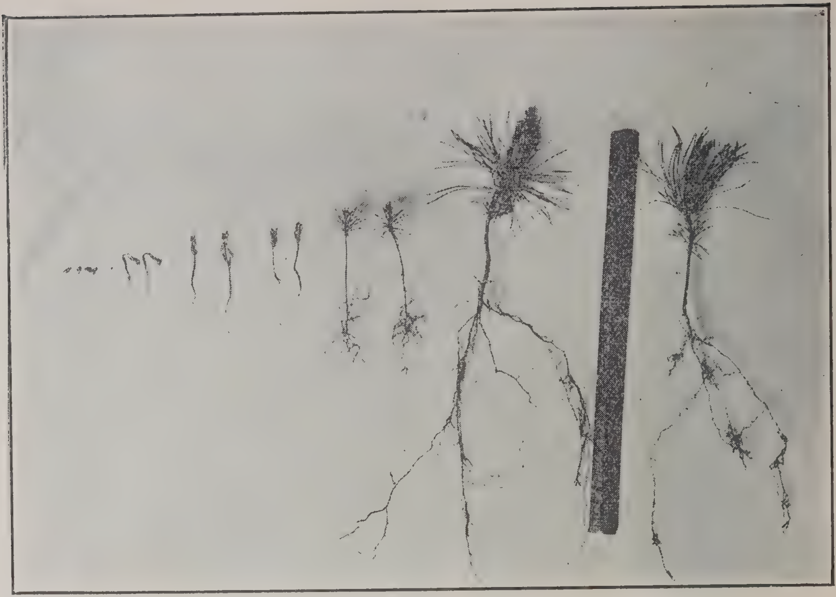

Fig. 14. DEVELOPMENT OF WHITE PINE SEEDS

Seedlings taken from nursery May, 1914, after growth had started. From left to right: Four seeds; six seedlings from fall-sown seeds showing 3 stages of development directly after breaking through the ground; two 1-year old seedlings; two 2-year old seedlings

Fig. 15. STUDENTS PLANTING TREES

From 1,200 to 2,750 trees are planted per. acre. A crew of 20 men can plant 20,000 trees per day if conditions are favorable

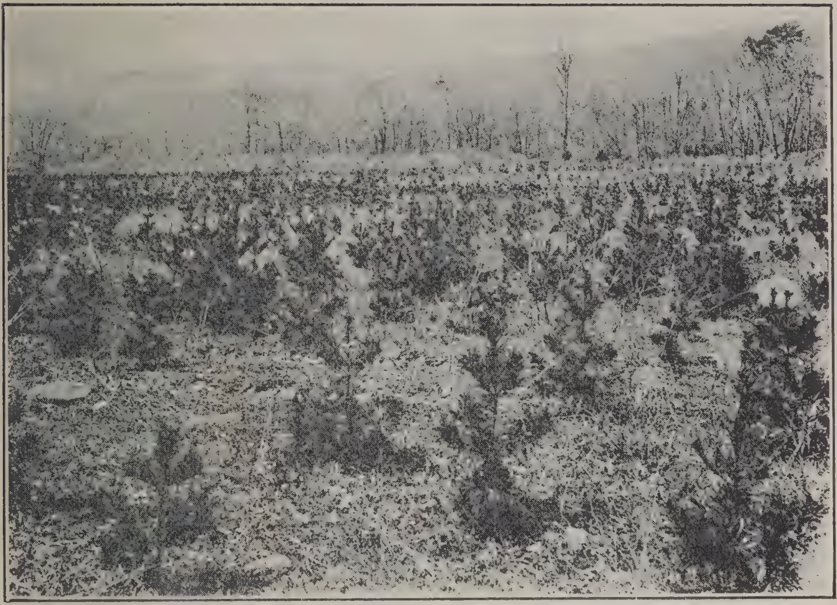

Fig. 16. PLANTATION OF WHITE PINE
Six years old from seed, about 2,700 trees, 2-3 feet high, per acre

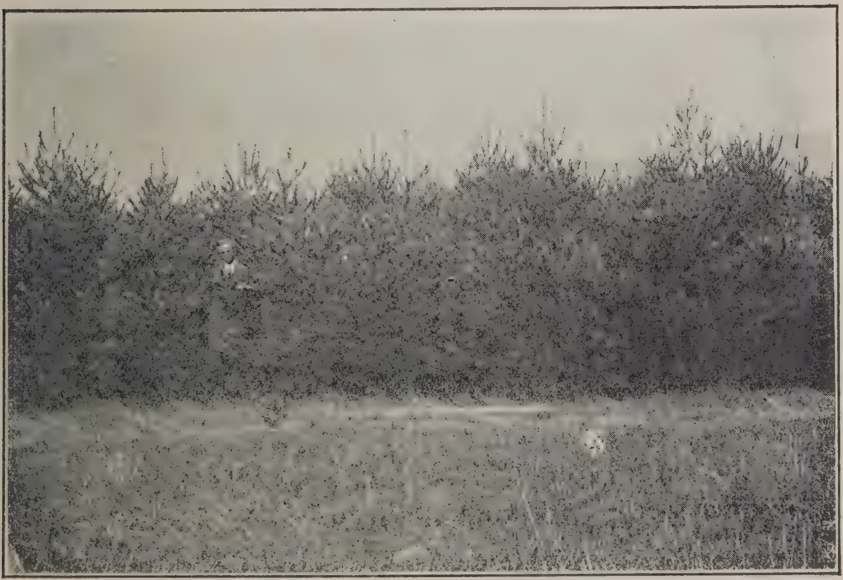

Fig. 17. PLANTATION OF WHITE PINE
Eleven years old from seed, about 2,500 trees, 5-12 feet high, per acre

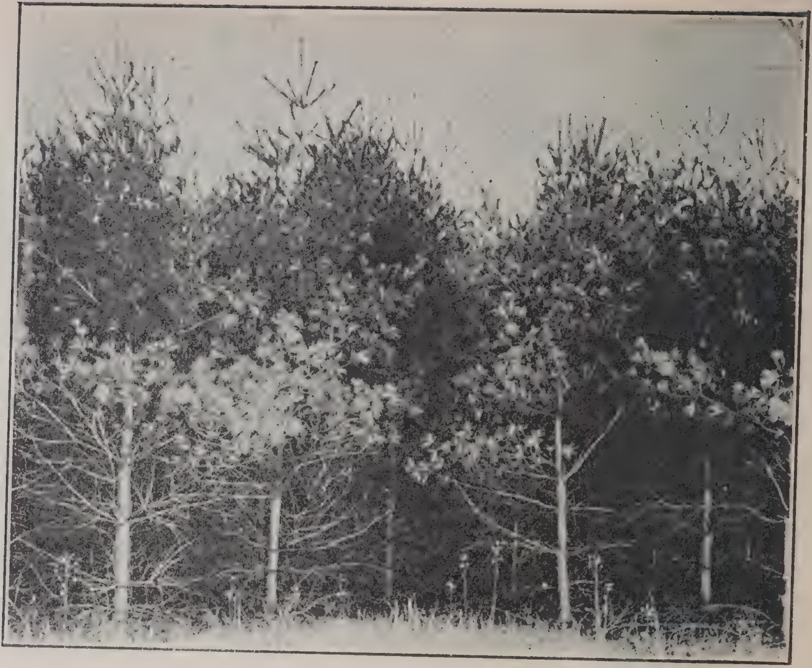

Fig. 18. MONAGHAN FIELD PLANTATION OF WHITE PINE
Photograph taken in the fall of 1916 when the trees had completed seventeen seasons of growth. Average height 14.9 feet

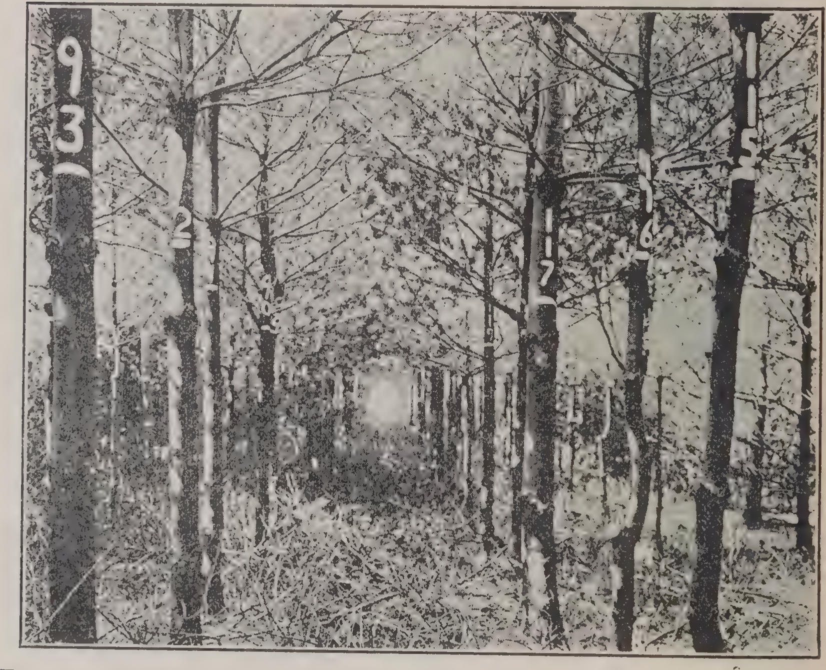

Fig. 19. SAMPLE PLOT IN MONAGHAN FIELD PLANTATION OF WHITE PINE
Each tree bears a special number and the breast-high point (4.5 feet from the ground) is marked by a white horizontal line. All diameter measurements are taken at the breast-high mark. A complete record of each tree is kept on file at the office of the forester in charge of the forest

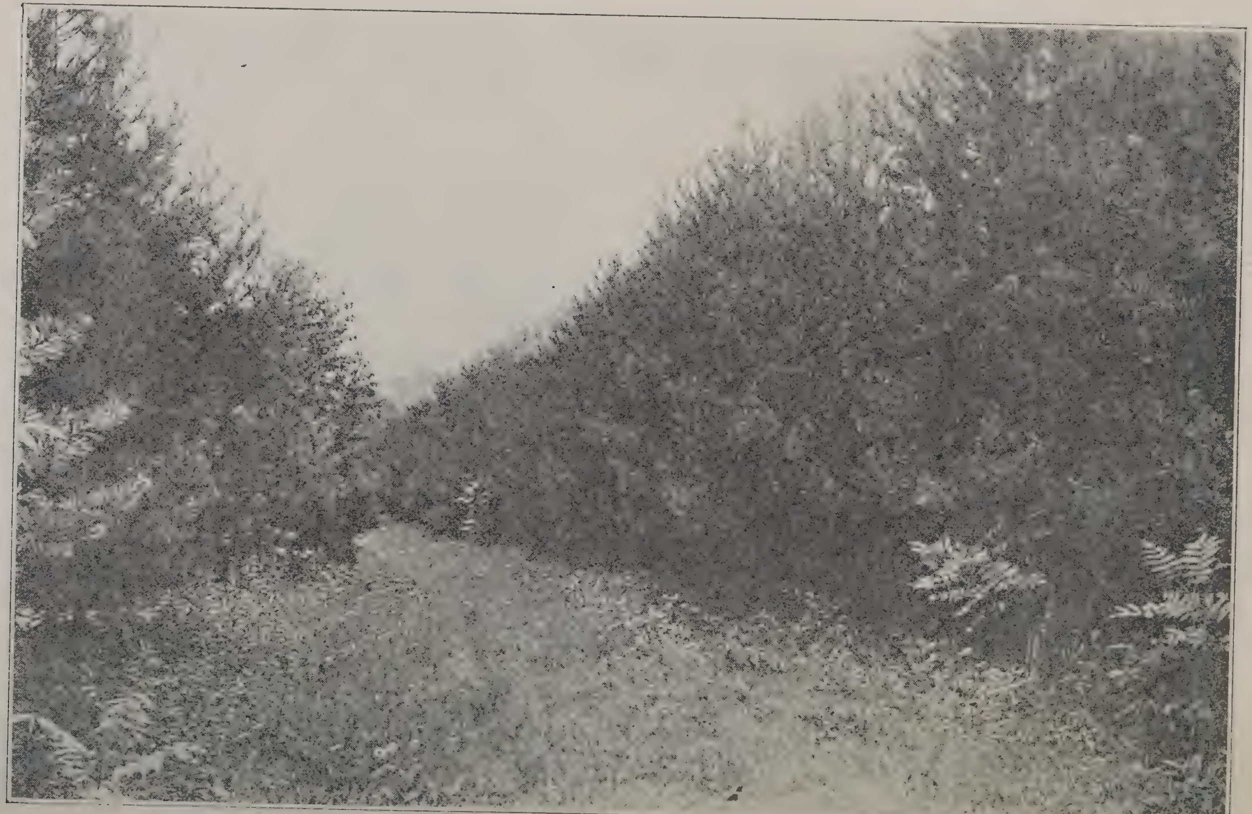

Fig. 20. THRIFTY PLANTATION OF WHITE PINE IN HUNTINGDON COUNTY

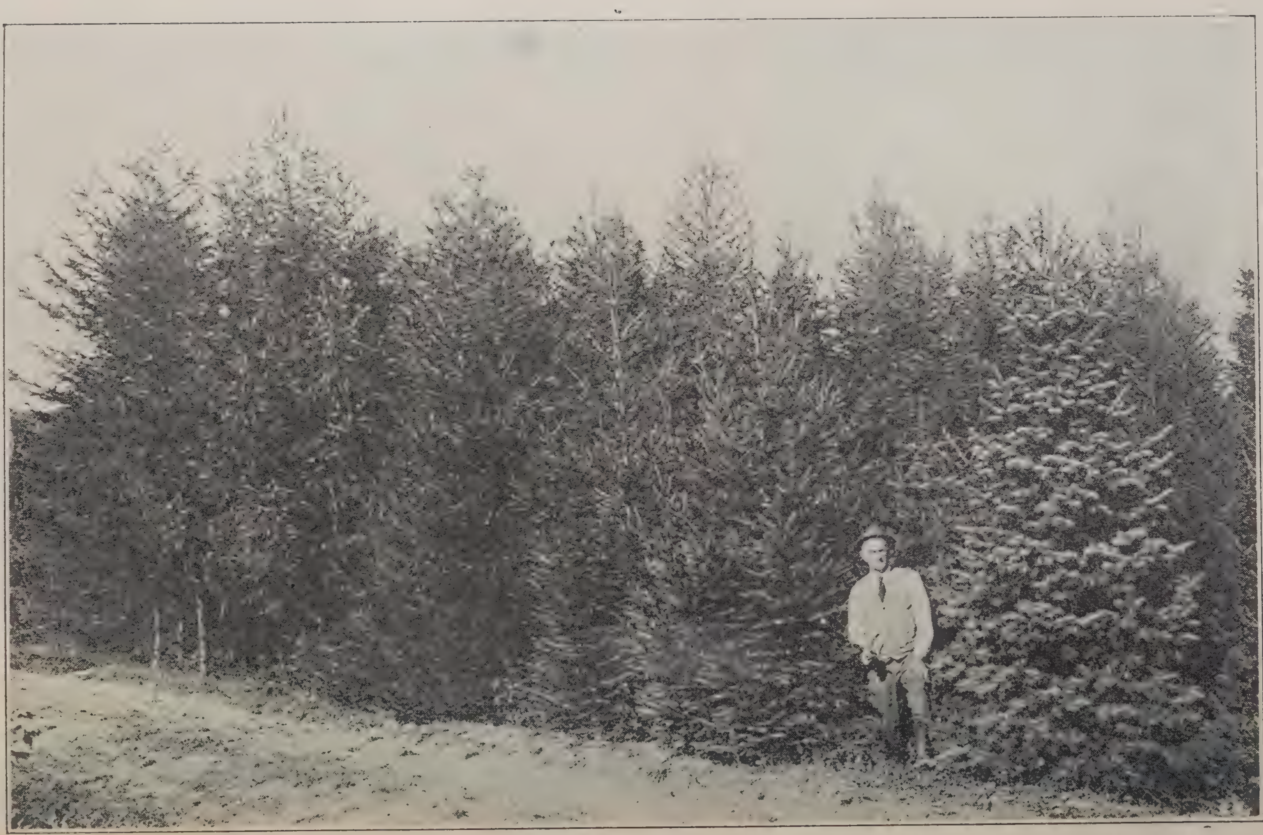

Fig. 21. ONE OF THE BEST PLANTATIONS OF FOREST TREES IN PENNSYLVANIA ON THE JACOB NOLDE ESTATE NEAR READING, PA.

or by a combination of the following methods:—(1) *Natural,* where nature, aided to a limited extent by man, sows seeds and produces sprouts. (2) *Artificial,* where man sows the seeds or plants the seedlings. The former is usually spoken of as natural regeneration and the latter as artificial regeneration. In both methods nature does most of the work; but man helps nature more in the artificial method than in the natural method. Nature working through many centuries produced the original forest. We cannot wait for nature to produce another original forest on our forest soils. It will take too long. We may assist nature and attempt even to improve upon its way of doing things; but we must be careful that we do not deviate too far from its methods for fear of being punished.

In the case of artificial regeneration it is necessary to collect seeds from desirable trees. These collected seeds may be sown immediately or stored. If stored, they must be protected from such animals as mice, squirrels and birds, and from drought. The seeds may be placed between layers of sand to prevent drying out. Those seeds which are sown immediately may be sown directly upon the area where they are expected to germinate and establish themselves or they may be sown in beds in a nursery where they in time develop into seedlings. Direct sowing may be in the form of broadcasting, where the seeds are scattered rather uniformly over the area, or spot planting, where only isolated or scattered spots, often regularly spaced, are sown with seeds.

The nurseries in which the seeds are sown may be permanent and located in the open, or temporary and located in the forest under the shelter of trees. The nursery is divided into a great number of beds which are usually about twenty-five feet long and four feet wide. The seeds may be sown in these beds in spring or fall, either by sowing them broadcast or in rills. Here the seeds germinate and after an incubation period of usually less than a month, but occasionally extending over a year, they appear above the ground. The germination can sometimes be stimulated by soaking the seeds in water before planting. These young tender plants like children succumb very readily to adverse conditions. Consequently they must receive careful treatment and adequate protection while they remain in the nursery. They must receive protection from the intense sun, excessive moisture, drought, weeds, fungi, and animals.

The plants which develop from the sown seed may remain for one, two, or three years in the nursery. Those plants which remain for more than one year may be kept in the same place where the seeds which produced them were sown. If too dense they must be lifted and planted in another place where they will have more room. This process of lifting the seedlings and planting them again is known as *transplanting,* and the resulting plants are *transplants.* Transplanting usually produces better plants because they are stockier and better prepared for the shock they will receive when planted in the forest. Trees like White Pine, Red Pine, and Norway Spruce are usually left in the nursery for two or three years and then transplanted, while other species like Ash, Walnut, and Oak are left in the nursery only one year.

The seedlings planted in the forest are usually raised in nurseries but occasionally they may be taken from the forest floor where nature often produces them abundantly. The cost of raising plants in the nurseries varies with the species, cost and quality of the seeds, and the length of time left in the nursery, but is usually from about $2.50 to $4.00 per thousand. The source, method of collection, preparation, and storage of the seeds have a marked influence on the quality of the resulting plants. The plants, taken from the nursery or lifted in the forest, are usually planted in the forest about 4x4 or 5x5 feet apart. This requires from about 1,700 to 2,725 trees per acre. The total cost of planting an acre of cleared land to forest trees, including cost of plants, is about $12. In individual cases the cost may exceed this figure and again it may be lower. This artificial method of regeneration is generally used where forests have been clear-cut or where openings are to be reforested. It is also used for underplanting where a better humus covering is desirable. In Europe, especially in Germany, this method was used extensively during the last century as may be seen in the many even-aged forests found there at the present time. During the last decade a reaction has been setting in, based on scientific investigations. Many of the forests which were established artificially are now reaching maturity. Disadvantages of this method are becoming more evident and the foresters are gradually substituting the natural method for the artificial.

The natural regeneration of forests may take place in two ways: (1) By coppice and (2) by seed. By coppice is meant the shoots which spring up from the stump when the tree is cut (Figs. 10, 28, 88, 98) and the suckers which spring from the roots. Coppicing is a rather important method of reproduction in Pennsylvania since some of our most valuable species, like Chestnut, Ash, and Oak reproduce readily by this method. Natural seed regeneration leaves most of the work to nature. Man attempts to hasten it somewhat by regulated cutting in the stand and by wounding the soil so that the seeds will find a favorable mineral soil upon which to germinate. The trees which produce the seed may be scattered singly, or occur in groups, in strips, or in open stands. These trees are known as seed trees or mother trees. Some form of natural regeneration must be used in protection forests, is advisable for game and park

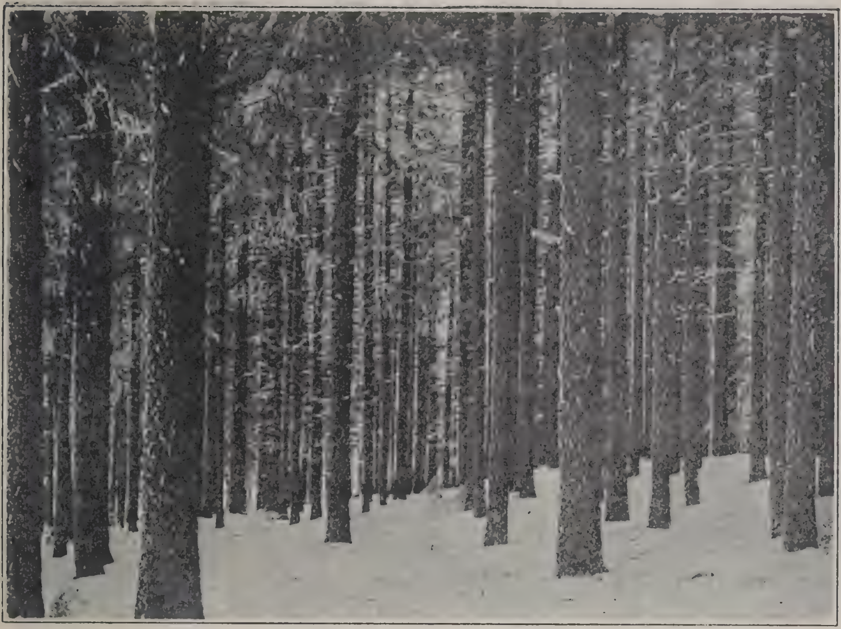

Fig. 22. NATURAL REGENERATION OF THE FOREST
Norway Spruce before seeding cutting. Opening the leaf-canopy stimulates seed production

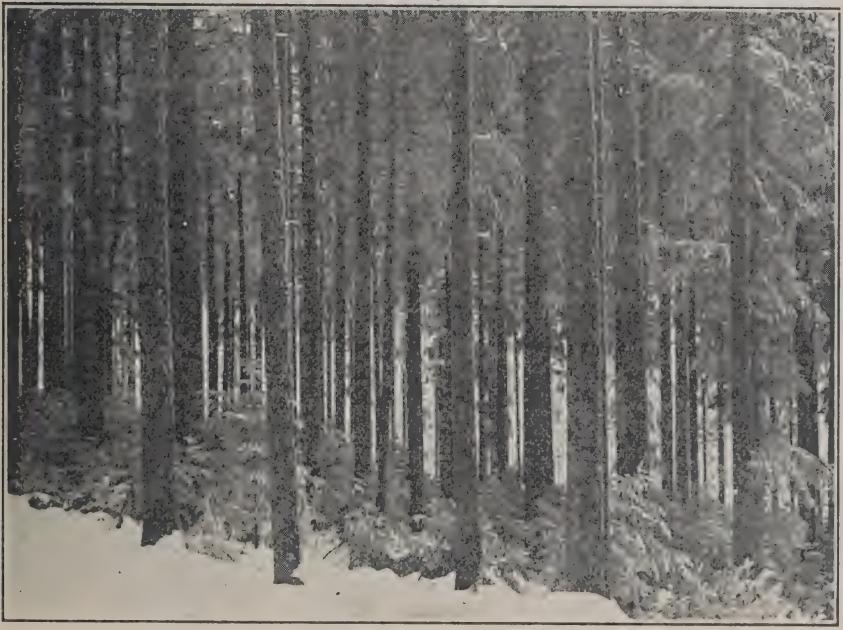

Fig. 23. NATURAL REGENERATION OF THE FOREST
Norway Spruce after seeding cutting. Regeneration follows regulated seed production

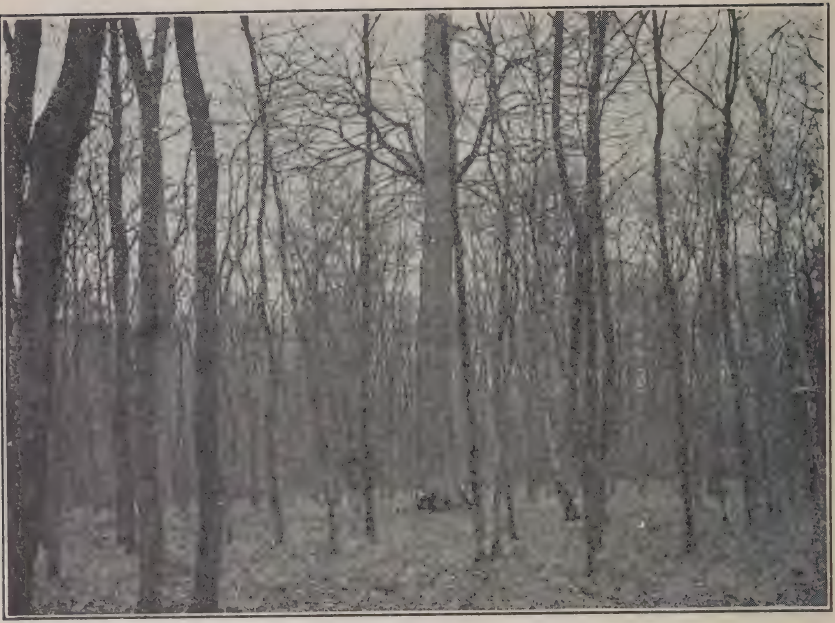

Fig. 24. NATURAL REGENERATION OF THE FOREST
A large Oak seed tree with its off-spring

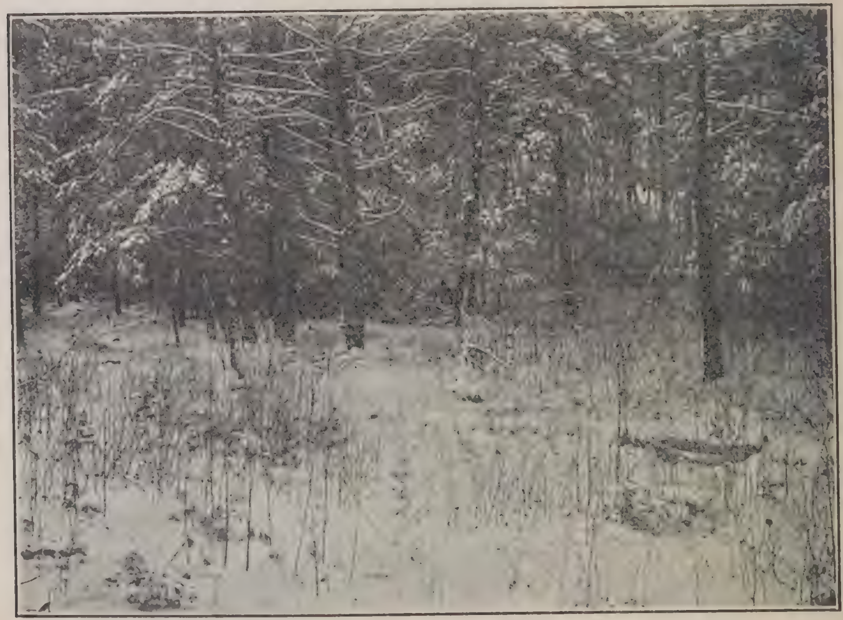

Fig. 25. NATURAL REGENERATION OF THE FOREST
An opening being filled by a dense growth of White Pine, Tulip, and Hemlock seedlings, from seed scattered by bordering large trees

forests, and applicable to the forests which are managed for the production of wood. In some cases it is advisable to begin with natural regeneration and then fill in artificially all places which are not stocked with trees.

THE DEVELOPMENT OF THE FOREST

The raising of some farm crops and the raising of a wood crop have many points in common. A farmer after planting his field to corn in spring does not leave it to nature to develop and mature, but he cultivates it and sometimes even cuts out undesirable sprouts called suckers, knowing that careful tending will result in a larger yield. Likewise the forester is not satisfied in establishing a forest but he also aims to develop or tend it so that it will yield a large and valuable crop.

The method of developing a forest depends upon the nature of the forest and the desire of the owner. The forest may have been established by nature and even partly developed by it or it may have been established by man. The forests established and developed by nature without the aid of man are usually in a rather unsanitary, unattractive, unproductive, and unregulated condition. Under such conditions it is necessary for man to transform these into forests which are clean, attractive, productive, and which show evidence of proper regulation on every hand.

The forests which man establishes usually start out with 2,000 to 20,000 or even 50,000 seedlings to the acre, depending upon the method of establishment. If artificial methods of regeneration are used about 2,500 seedlings per acre are required but where natural regeneration is used one may find 20,000 or even 100,000 seedlings per acre. If we go into a mature forest stand and count the trees per acre we will find probably 150, or sometimes 250, and occasionally 400; hence. we must conclude that a large proportion of the trees which start out cannot survive. Two questions suggest themselves: What happens with the large number of trees which cannot mature? Why is it necessary to plant so many when only a small number can mature? If one inspects a plantation of trees a few years after it was established he will be able to note a difference among the trees. Some are thrifty, which is shown by their rapid growth, others are average, while still others show no signs of growth whatever or may have died. If one returns ten years later this condition is still more pronounced. By this time they will have grown to such dimensions that their branches are beginning to interlace. A struggle has started between them. There is no longr sufficient space for all of them. They must battle with each other for light and food. Some will conquer and be known as dominant trees, while others will just about hold their own and be known as intermediate trees, while still others will be conquered and be known as suppressed or dead trees. This struggle for existence is found in all places where trees grow in the form of a forest, and results in the elimination of the weaker specimens. At the same time it gives such drastic discipline to the dominant ones that they will produce a much higher grade of wood. Trees grown in dense stands are usually free from lateral branches for a considerable distance from the ground and as a consequence the logs cut from them will be relatively free from knots; while trees grown in open stands or in open situations bear crowns which often reach almost to the ground and produce numerous knots. Such trees as the latter, consequently, yield an inferior grade of wood.

In developing forests the owner or forester in charge should aim to maintain a proper number of trees per acre and to treat them so that they will not only yield a large quantity but also a good quality of wood. He should not aim to differ from nature's ways of doing things but improve on them. In order to improve the forest it is necessary that the forester carry on certain operations in the immature stand which aim to improve the composition of the stand and form of the individual trees. He should also aim to increase the rate of growth of the individual trees and as a result increase the yield in volume and value of the final product. The principal operations which one must carry out in order to realize the above objects are: Cleanings, Assistance Cuttings, Liberation Cuttings, Thinnings, Damage Cuttings, Pruning, Weedings, and Underplanting.

Cleanings are cutting operations in young rather even-aged stands which remove undesirable trees with little prospective value, and favor other species with a good prospective value. These later may have been overtopped by the undesirable ones.

Liberation Cuttings are operations in immature stands in which the main crop of trees is overtopped by scattered older trees with very wide-spreading crowns. These older trees which at present have but little prospective value retard the development of a great number of younger trees with good prospective value. The removal of the larger trees is known as a Liberation Cutting.

Thinnings are cutting operations in immature stands for the purpose of accelerating the growth of individual trees and, as a consequence, increase the total yield and improve the quantity of the product. Thinnings result not only in a large quantity and quality increment but aim to improve the appearance and health of the forest. They decrease the danger from fire since a large amount of inflam-

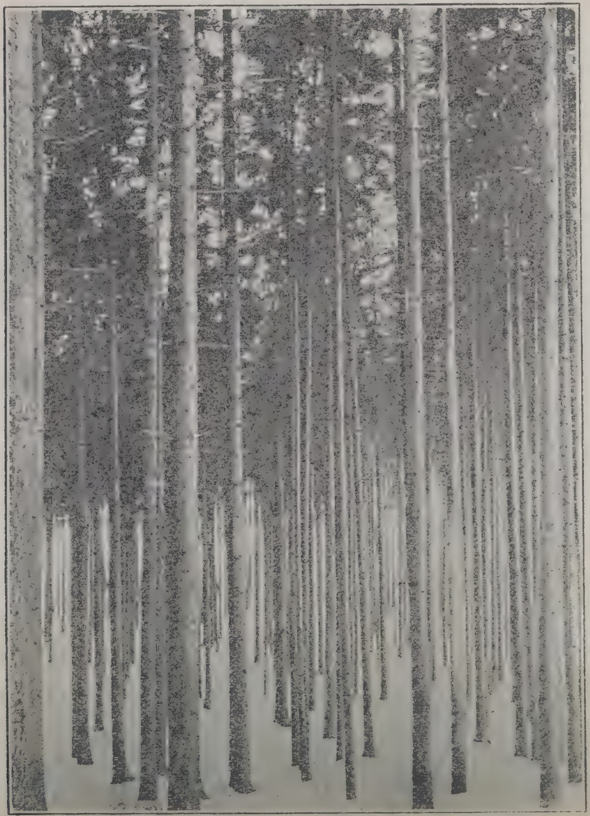

Fig. 26. CLOSED STAND OF SPRUCE
Crowns shallow, stems clean, little taper, relatively large quantity of high class wood. Pruned by nature

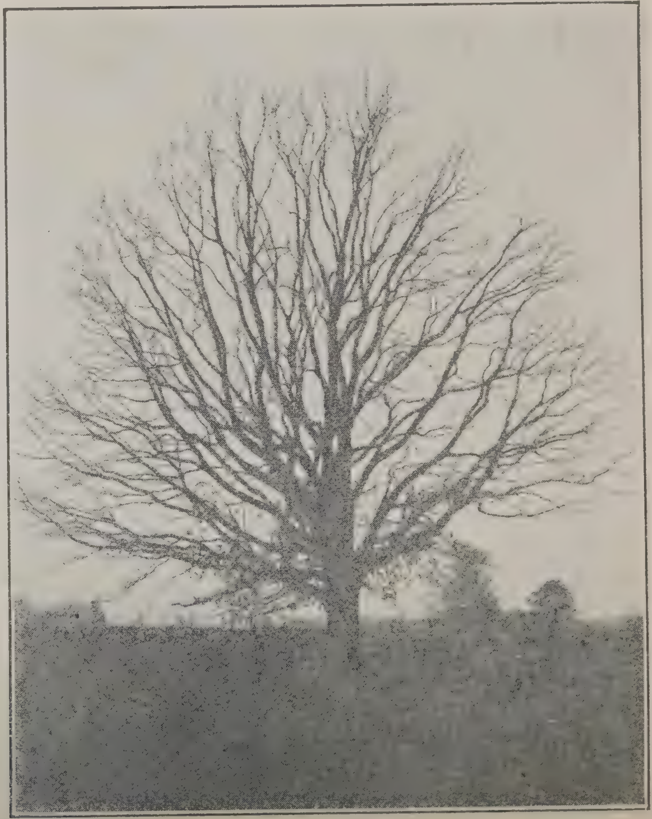

Fig. 27. OPEN-GROWN WHITE OAK.
Symmetrical, branches near the base. Will produce considerable cord wood, but little saw timber. Compare forest-grown White Oak in Fig. 12.

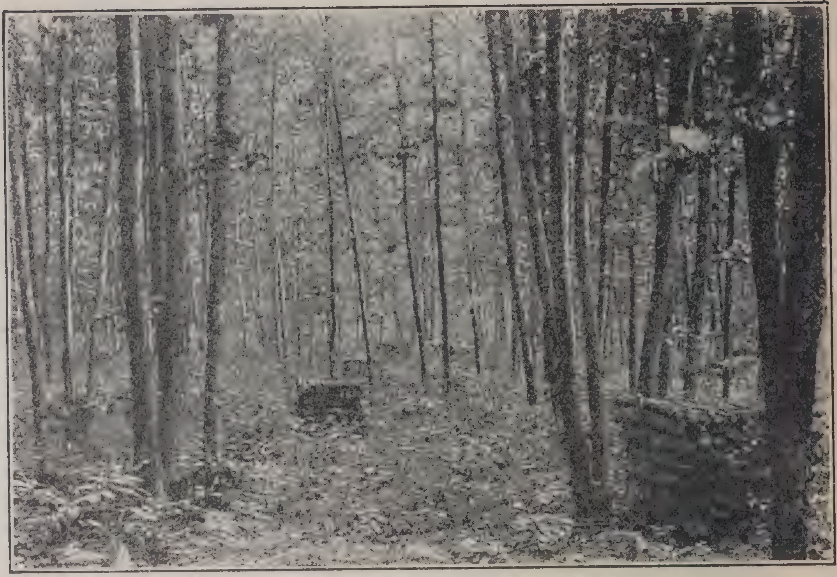

Fig. 28. THINNED CHESTNUT STAND
About 35 years old. Approximately 280 trees over 4 inches in diameter, breast high, still standing. Eight cords of wood per acre were removed

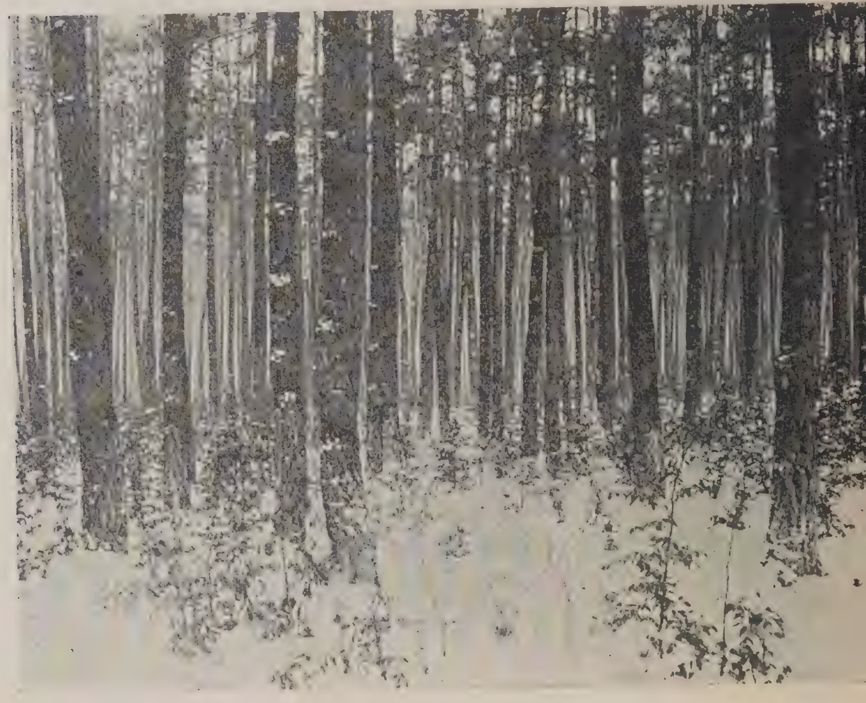

Fig. 29. THINNED SCOTCH PINE
About 70 years old. Underplanted with Beech

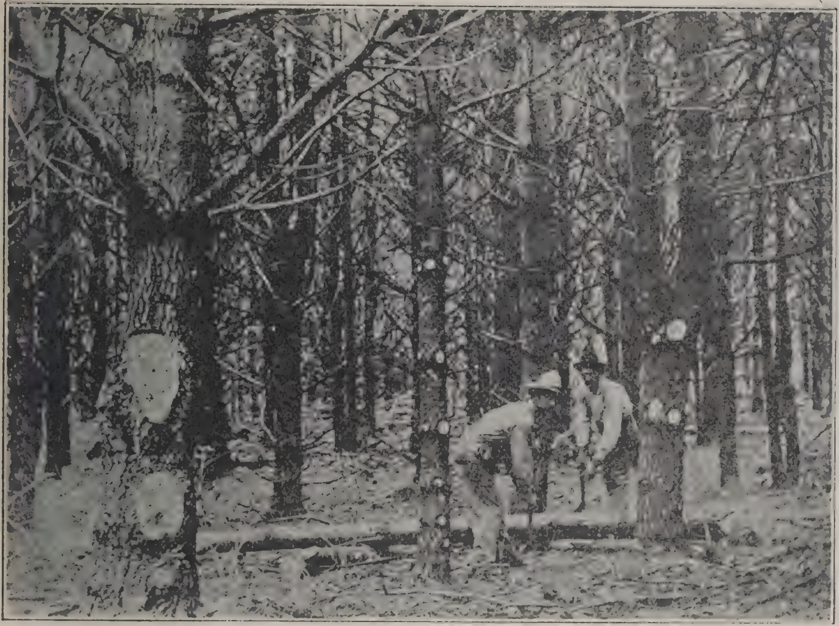

Fig. 30. WHITE PINE STAND BEFORE AND DURING PRUNING

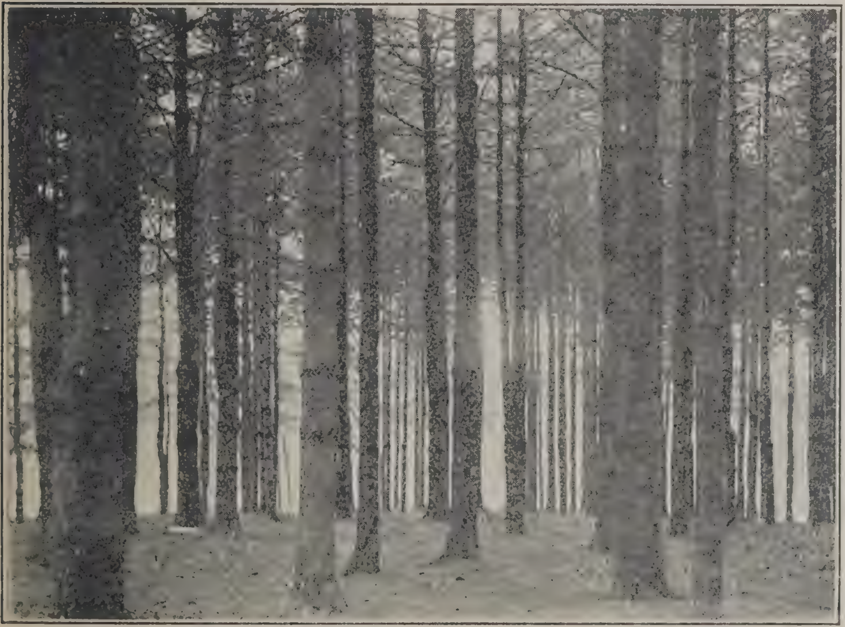

Fig 31. SAME STAND AS FIG. 30, 10 YEARS AFTER PRUNING

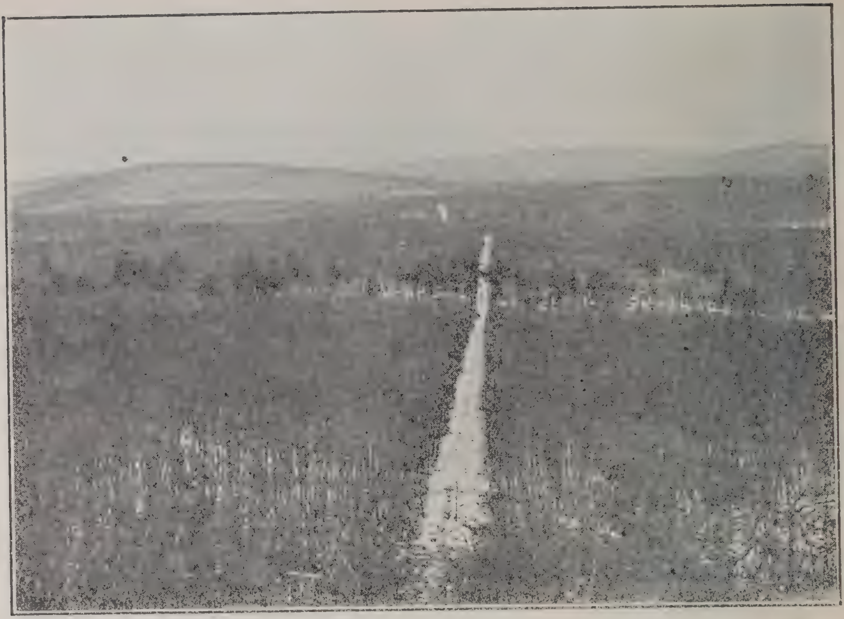

Fig. 32. OIL PIPE LINE AS A FIRE AND SUBDIVISION LINE
A base from which to fight fires. An excellent subdivision line

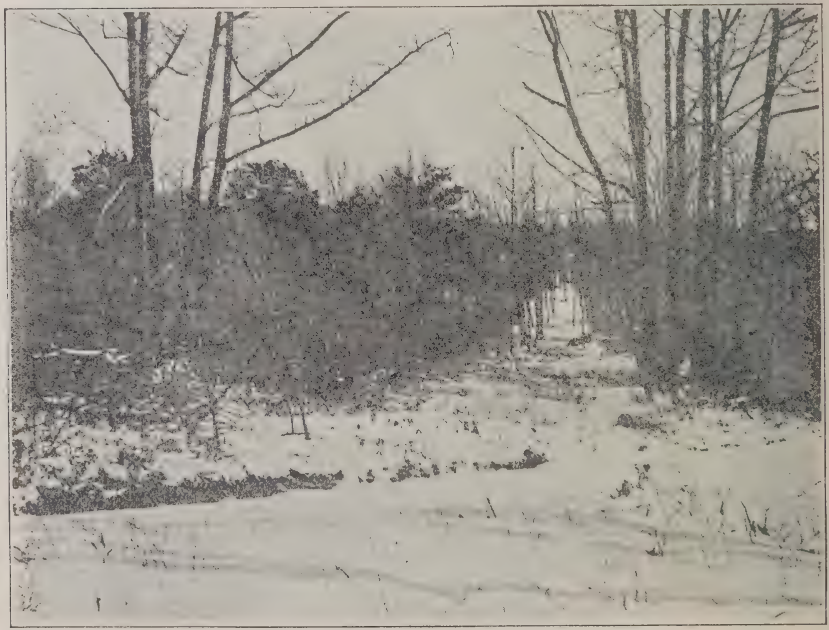

Fig. 33. COMPARTMENT LINE IN A YOUNG CHESTNUT FOREST
Such lines afford a base for controlling fires, and make the forest accessible

mable debris is removed. If thinnings are conducted properly the remaining trees are usually more windfirm. Thinnings also enable one to get returns upon a forest investment without waiting until the crop is finally harvested. Today, under our crude method of regulating the returns from our forests, the thinnings or intermediate yield play a minor role, while the final yield comprises practically the total yield; but as our methods are developed and perfected, the intermediate yields will comprise as in the intensively managed forests of Germany, 25%, and later, 50% of the total yield. All forest owners should aim to improve their forest stands by thinning them properly so that they will become more attractive, more sanitary, and more productive. This may be accomplished by thinning early, regularly, and with increasing intensity, but always cautiously, so that the fertility of the soil will be conserved and all available food properly utilized.

Damage Cuttings comprise operations which remove all damaged material from the forest. The damage may be caused by wind, lightning, snow, insects, fungi, fire, or any of the many other agents which operate in the forest. Damage cuttings should be made as soon as possible after the damage is done not only in order to utilize the material before it depreciates too much in value, but also to prevent the spread of such destructive agents as insects and fungi.

Pruning is an expensive operation and consists mainly in cutting off the lower branches of trees where they were not pruned naturally, in order to produce stems with as few knots as possible and at the same time increase the beauty of the stand.

Underplanting is an intensive cultural operation which is practiced only under systems of intensive management of the forest. It may aim to conserve or even improve the soil or to establish advance reproduction. The aesthetic value of underplanting is also a valuable asset in developing our forest.

Environmental influences and inherent tendencies are factors which are constantly discussed in connection with the development of our youth into useful men and women. These same factors should be considered in developing the young seedlings of the present forest into the veterans of the future.

THE PROTECTION OF THE FOREST

The protection of the forest surpasses in importance all other forest activities during the early or formative period of forestry in any country. Forest protection is not only the oldest but also the most necessary branch of forestry. Many and varied are the destructive agents at work in the forest or upon the products derived from it.

The destructive work of fire is very evident while that of fungi is often hidden. One cannot help but comprehend the destructive work of a forest fire which may sweep over an entire mountain, kill every trace of tree growth, and, in addition, destroys buildings and occasionally human lives; but few even apprehend the extent of damage by such agents as fungi which often cause the decay of the entire interior of a tree without giving any external evidence of their presence.

In order to give adequate protection to our forests, it is necessary to know the dangers which threaten them. We must also know how to offset attack by employing preventive and remedial measures. The principal dangers which threaten the forest and against which man must protect it may be grouped as follows:—1, Damage from human agencies. 2. Damage from organic agencies, 3. Damage from inorganic agencies.

Man's disturbing influence in the forest can be comprehended in part when one compares our present forests with those of the past. Primitive man had few wants, but as his civilization progressed his wants multiplied and his destructive tendencies became more apparent. The early settler found it necessary to destroy valuable forests for the purpose of establishing a home and for opening agricultural and grazing lands. He had no alternative then, but now conditions have changed. He is just at the beginning of forest appreciation. He must introduce system and substitute conservative forestry for destructive lumbering, which latter has always been characterized by profligate exploitation and wanton waste.

Man is directly or indirectly responsible for most forest fires, since they usually originate through his carelessness or maliciousness. Lightning is responsible for a very small percentage. Of all the enemies of the forest none is so destructive as fire. A single fire may burn over a few acres only or it may burn over thousands of acres in a single day. It not only destroys present but prospective value, since it consumes or kills mature trees and the young seedlings and saplings which would have produced the forest of the future. In 1922, 3,635 fires occurred in the State of Pennsylvania, and burned over 332,327 acres. The estimated amount of damage was over $670,000. The loss to the people of Pennsylvania on account of forest fires is estimated to be not less than $100,000,000.

Three kinds of forest fires are usually recognized: *Surface fires,* which burn the surface layer of leaves, grass, twigs, and some trees: *Ground fires,* which burn through soils with abundant vegetable materials and *Crown fires,* which burn through the crowns of trees.

Many fires can be prevented by educating the people concerning the real value and significance of the forests. Vigilant patrol dur-

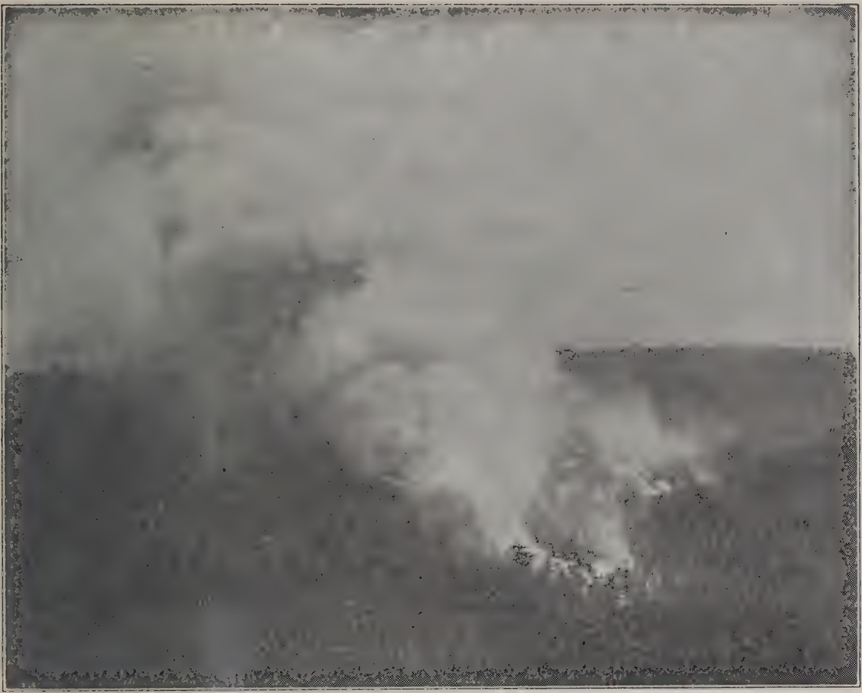

Fig. 34. A DESTRUCTIVE FOREST FIRE WELL UNDER WAY

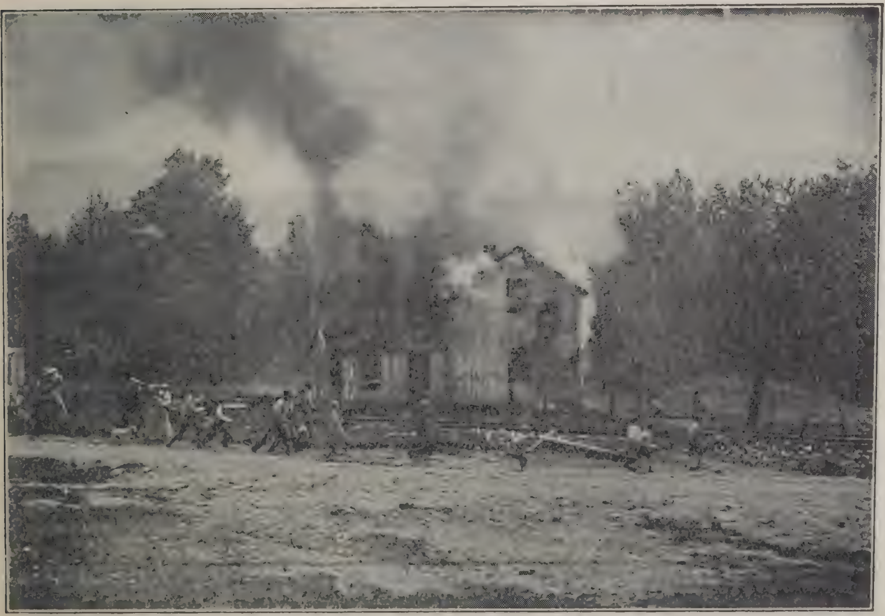

Fig. 35. SEVERE FOREST FIRES CONSUME PRACTICALLY EVERYTHING IN THEIR COURSE
Homes, even entire towns have been destroyed

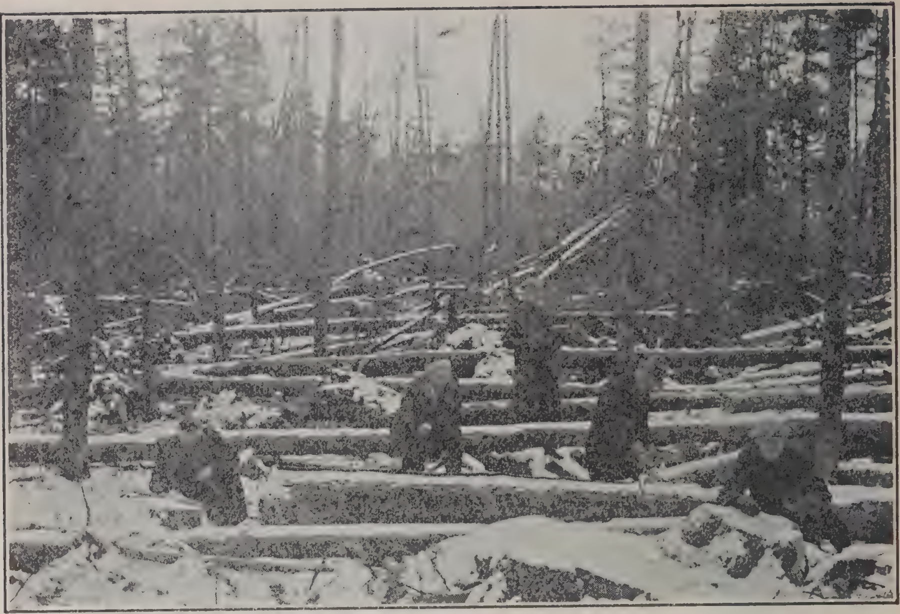

Fig. 36. ESTIMATING THE DAMAGE OF A WINDFALL

Proper stand management, a systematic establishment of cutting series, and judicious felling reduces damage by wind. During a single storm on April 10, 1918, over 100,000 board feet of Pitch Pine timber was blown down upon a small area on the Mont Alto State Forest

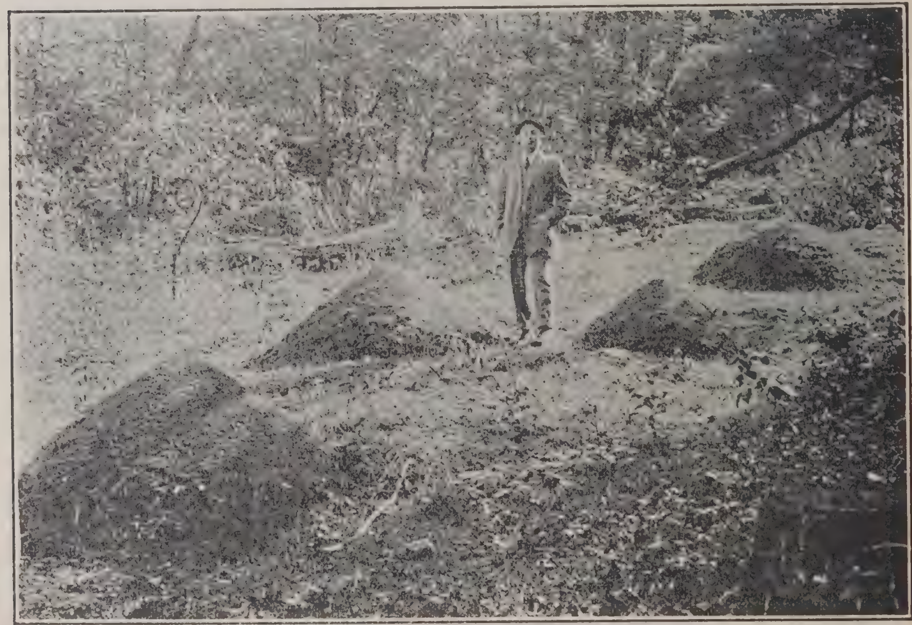

Fig. 37. AN EXAMPLE OF THE DESTRUCTIVE WORK OF MOUND-BUILDING ANTS

No trace of woody vegetation remains near the hills. Bedford county, Pa.

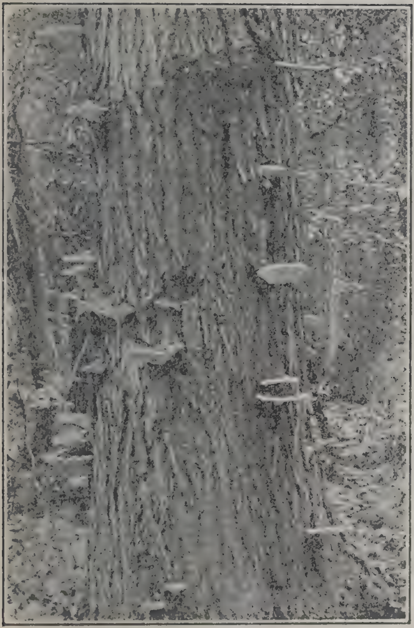

Fig. 38. HEMLOCK TRUNK WITH FRUITING BODIES OF A FUNGUS

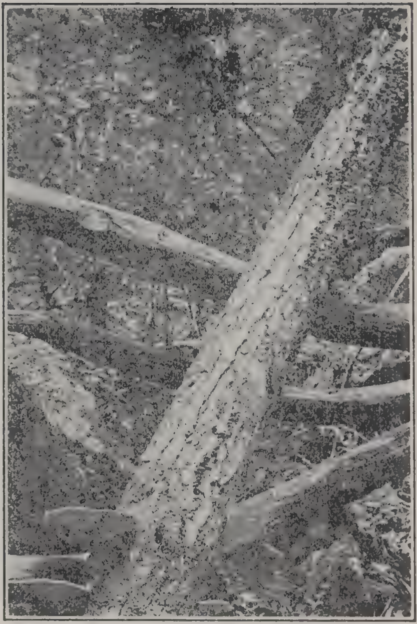

Fig. 39. BLACK BIRCH TRUNK ATTACKED BY TWO DIFFERENT SPECIES OF FUNGI

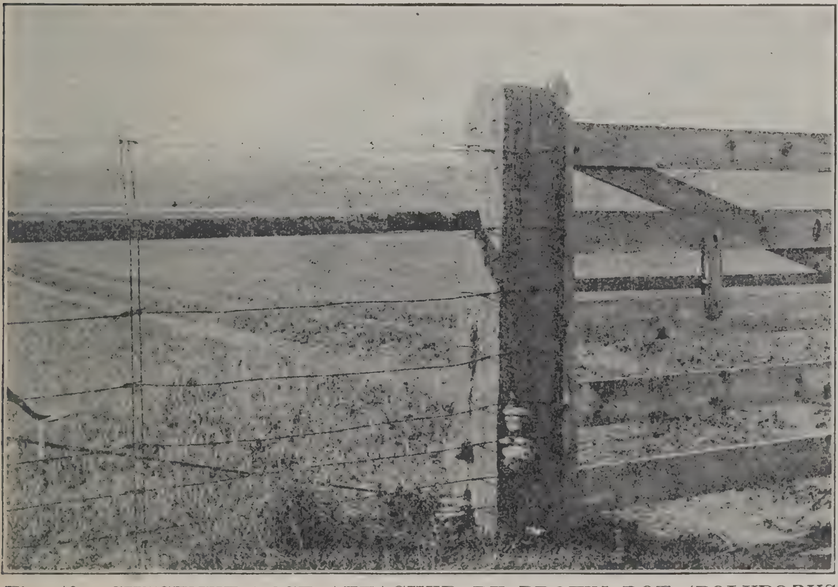

Fig. 40. CHESTNUT POST ATTACKED BY BROWN ROT (POLYPORUS SULPHUREUS)

Some fungi attack only living wood, others attack only dead wood

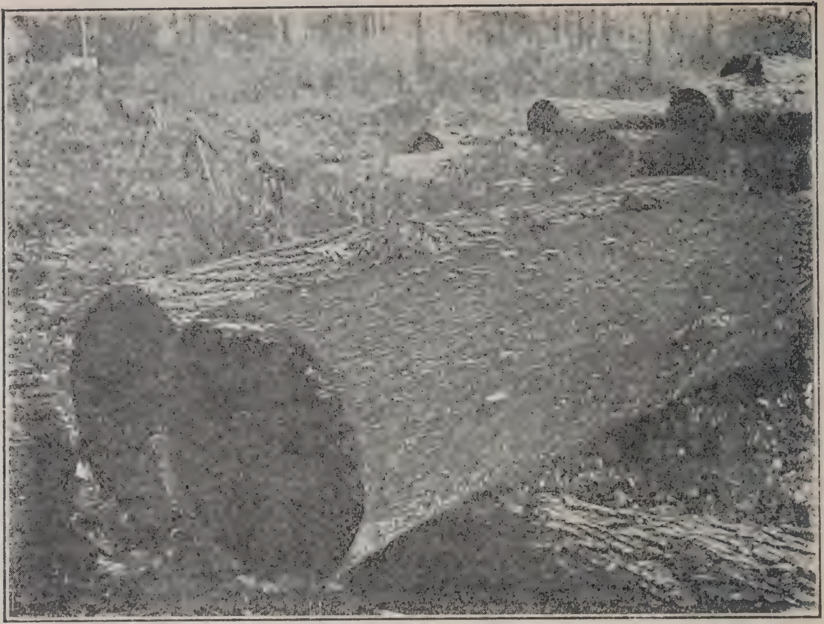

Fig. 41. WHITE OAK AND PINE LOGS ATTACKED BY FUNGI
The White Oak logs in foreground attacked by 3 different species of fungi. Cut about 8 months before photographing. The value has depreciated with exposure and fungous attack

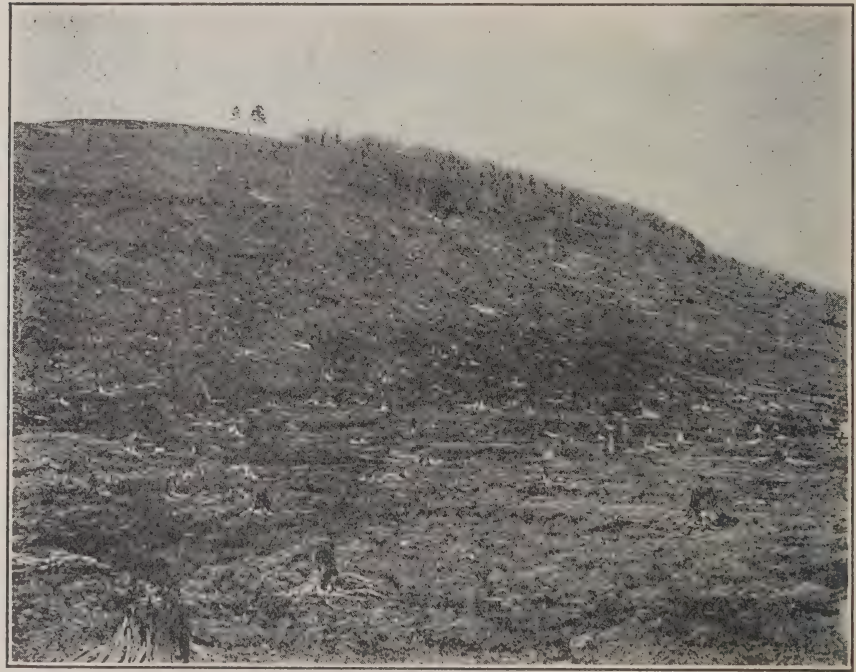

Fig. 42. RESULT OF DESTRUCTIVE FOREST EXPLOITATION
Denuded hillsides covered with a dense growth of grass, which practically prevents the establishment of a forest growth. Tioga county, Penna.

ing the danger season, the construction of fire-towers, telephone lines, roads, fire-lanes, compartment lines, and the proper disposal of combustible material, help to minimize the fire danger.

The damage which man does in the forest is very noticeable to his fellowman, while that done by other agents often goes unnoticed. Due to the development of our biological sciences in the recent past we are beginning to appreciate the extent of the damage done by such agents as insects and fungi.

The organic agencies which damage the forest are plants or animals. The principal types of plants which do damage to the forest or to the products of the forest are parasitic flowering plants, as the mistletoe, and fungi which cause the decay of wood. The extent of damage which fungi do to trees as well as construction timber is usually underrated. They may be found upon living or dead trees, stumps, logs, railroad ties, and construction timber in bridges, houses and barns (Figs. 38-41). The Chestnut-Bark Disease is an example of a parasitic fungous disease which attacks the Chestnut tree. It is now found in all parts of Pennsylvania. The Chestnut tree is doomed for in a few years no Chestnut trees of commercial size will remain in the State.

Many different kinds of animals do damage to the forest. Domestic animals, as cattle, sheep, goats, and hogs, and wild vertebrates, as deer, rabbits, squirrels, mice, and beavers, are among the most important damaging agents.

Next to fire, insects are the most destructive enemies of the forest. They may infest young seedlings in the nursery, the fruit or seeds, the twigs, the cambial bark, and the wood. They also do considerable damage by attacking the leaves. Complete defoliation is not uncommon.

The damage from inorganic agents may be in the form of windfall, wind-break, snow-break, excessive cold, excessive heat, shifting-sands, erosion, floods, and noxious gases.

Proper protective measures can sometimes be carried out successfully by the individual, but in other cases the co-operation of the nation, state, or municipality may be required. By developing the forest fire organization in Pennsylvaina, forest fires will be rare events, as in the managed forests of Europe, and if they break out will cause relatively little damage.

THE VALUE OF FORESTS

Prior to the time that the conquest of Constantinople closed the route to the Orient, the Atlantic was regarded the world's back door. Columbus, a mere sea captain, to his own suprise, discovered a land which, as the old voyagers related, no one approached without appreciating the beauty of the forest. Those old voyagers appreciated the beauty of the forests but not the prospective value. The forests at first had a negative value. They were something which must be conquered. Their removal was necessary for the establishment of homes and the opening of agricultural lands. Thousands of acres of the best forests were simply burned to get rid of them. They were obstacles in the way of development.

Gradually as our forest acreage decreased, as our population increased, and as the demand for wood goods multiplied, the forests became not only objects of interest and beauty, but also of value. After four centuries of rapid development we are just beginning to comprehend the real importance of our forests. They supply us with wood which is the most indispensable and universally used product of nature. Wood as a necessity or a luxury is used in our various activities from the cradle to the coffin. Many of our houses are built, finished, and heated with wood. Most of the paper upon which we write and upon which our books are printed is made of wood.

The forests supply us not only with wood but with many minor products like maple sugar, tanning materials, naval stores, charcoal, wood alcohol, etc. Artificial silk and even whole suits of clothing have been made from wood. In addition, the forests furnish leaves for stable litter, pasturage for cattle, pannage for swine, and great quantities of nuts which are used as food by men. Pasturage was formerly carried on more extensively than at present. It may be a legitimate industry if it pays and if it is so directed that the young seedlings in the forest, which will produce our future forests, are not eaten or injured. As a rule, grazing should not be permitted in young forests where the shoots are still tender and readily eaten by animals, nor where the grazing animals may tramp out the seedlings.

The original forest may be regarded a great reservoir of wealth filled by nature working through many centuries, and exploited by man either for its products or to establish in its place a more necessary industry. The present forest on the other hand may be represented by a much smaller reservoir only partly filled, and with material which is inferior not only to that found in the original forest but also far inferior to that which we hope to develop in the future forest. The present forest if properly managed, which implies improvement, is capable of producing continuously a large quantity of major and minor forest products representing an enormous value. In addition to the usual monetary value of forests we should also consider their value as soil formers, soil fixers, soil im-

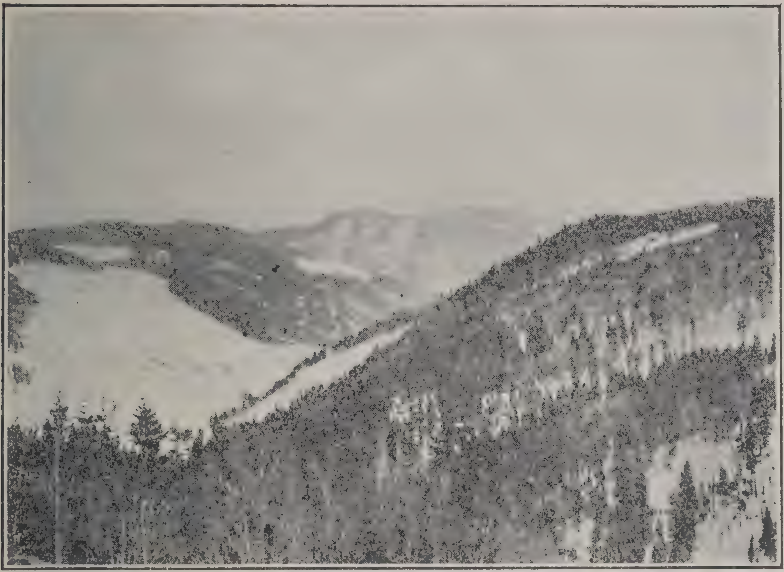

Fig. 43. TREES FURNISH A PROTECTIVE COVER TO STEEP MOUNTAIN SLOPES, AND CONSEQUENTLY CHECK EROSION AND PREVENT FLOODS BY REGULATING THE RUN-OFF OF WATER RESULTING FROM HEAVY RAINS AND MELTING SNOW

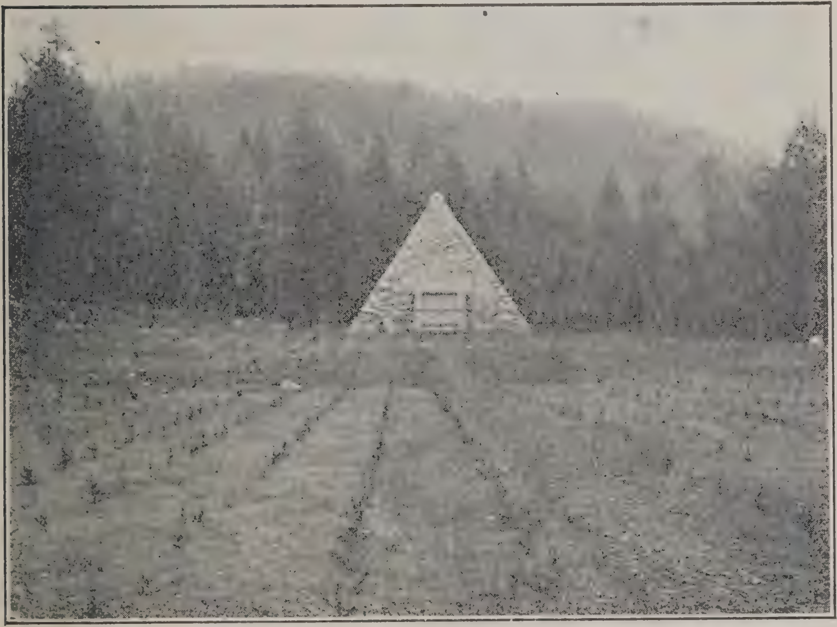

Fig. 44. PRESIDENT JAMES BUCHANAN'S BIRTHPLACE
Buchanan State Forest, Stony Batter, near Mercersburg, Franklin county. Pyramidal rough stone monument. Norway Spruce planted in the foreground

provers, preventers of floods, sanitary agents, suppliers of natural blessings, and beautifiers of the earth.

THE VALUE OF TREES

Trees are among the commonest and most conspicuous objects of nature. They vary considerably depending upon their kind, their environment, and the artificial treatment which they may have received during their development. The trees which surrounded the simple home of the early pioneer differed very much from those which adorn the grounds of some of our wealthy citizens to-day, showing that nature, unaided by man, produces trees in the forests which differ considerably from those which man has planted and cared for. Environment is a very potent factor which not only influences the general appearance of a tree but also the structural parts which compose it. Trees as members of the forest stand have been considered in the preceding chapter. The subjoined material treats of trees used for purposes other than forestry.

Trees are not only valuable for their products, as wood, resin, fruit, and litter, but in addition have an aesthetic and a protective value. Although tree-planting for shade and ornament has been practiced assiduously in past generations, yet the value of such planting and the care which such trees require and should receive has not been fully appreciated until lately. To-day individual trees or small groups of them are planted rather extensively about homes, along streets, in parks and public squares, for their shade and shelter. They are also used about the home to screen objectionable objects, to direct and restrict the views along general lines, to frame the home picture and to give the surroundings the expression of comfort and homeliness.

The establishment and care of shade and ornamental trees is entirely different from the care of forest trees. Knowledge concerning the life-history of trees in general is, however, a prerequisite for the proper treatment of both classes of trees, but the art by which this knowledge is applied is entirely different. The Forester grows trees to harvest, and at harvest time he aims to obtain from them as much and as high grade wood as possible. The tree warden grows trees to preserve. He aims to develop a tree with as desirable an appearance as possible and to retain it as long as the vitality of the tree will permit.

Thousands of dollars are spent annually by shade and park commissions in developing the aesthetic side of our cities, towns, and many of our rural districts. The commissions or individuals who have this in charge, aim, by beautifying the environments, not only to improve the health and efficiency of the citizens, but also to raise their moral standard and hence increase their social worth.

DECIDUOUS AND EVERGREEN TREES

All trees native to the State of Pennsylvania, when in a healthy condition, bear green foliage in summer. In autumn many of the green leaves change to brilliant colors, yellow, scarlet, deep red, or purple, and gradually fall to the ground. The trees whose leaves lose their green color and fall in autumn are known as *deciduous trees.* Most of the trees native to the State of Pennsylvania are deciduous. The deciduous trees are also known as hardwoods or broad-leaf trees. The Oaks, Maples, Birches, and Chestnuts are common examples of this group. Many of the representatives is this group yield valuable products and furnish interesting objects of study on account of their variation in form. In winter the deciduous trees are far more conspicuous than in summer since the dense leaf canopy is absent. This affords an opportunity to study the trees with special reference to their form, branching, and bark. These characters are among the most helpful in distinguishing our common trees, especially since they are at hand at all seasons of the year. The leaves of a few deciduous trees like the Beech and some of the Oaks die in autumn but often persist through the winter.

Some trees, however, do not shed all of their leaves in fall. Such trees are known as *evergreen trees.* The evergreen habit is characteristic for most trees commonly known as conifers. Most of the conifers have needle-shaped leaves which persist for two or more years. The Larch, native to this State, and the introduced Bald Cypress are, however, two trees which shed all their leaves in fall and during the winter appear like dead conifers. The persistence of the foliage of most of the conifers enriches the winter scenery and affords shelter for birds and other animals. Many conifers are highly prized for ornamental purposes and some yield valuable commercial products. The Pines, Spruces, Firs, Cedars and Hemlocks are the commonest examples of his group. In addition to the conifers a few broad-leaf species, such as Rhododendron, Mountain Laurel, and American Holly, are evergreen. A transition from the evergreen to the deciduous habit may be found in the Deciduous Holly and the Laurel Magnolia which are deciduous in the northern and evergreen in the southern states.

The deciduous trees are commonest in the eastern part of North America while the evergreen are commonest in the western part. The former are usually found in mixed stands, while the latter often occur in extensive pure stands. The hardwood trees usually occur on rather fertile soils while the conifers may thrive on more sterile ones. Both the deciduous and the evergreen habits have their advantages. The shedding of the leaves in fall is a protective adaptation since it reduces transpiration, danger from snow-break, and damage from noxious gases. The evergreen trees have the advantage of lower summer transpiration and are ready at any season of the year for constructive activity. They are also less subject to damage by frost during the growing season. The advent of forestry may change the structure and distribution of our forests. The present tendency seems to be gradually and cumulatively in favor of the conifers.

THE AGE OF TREES

Some trees reach great size and enormous age while others remain small and die young. The size and age which a tree attains depend upon their inherent tendency and the factors of the environment. Some trees which naturally grow tall and become old may remain small under unnatural and unfavorable growth conditions. Others never become large and old even under the most favorable growth conditions since it is inborn in them to remain small.

A definite age limit cannot be fixed for each kind of tree but for general convenience we may classify our common trees as short-lived, or long-lived. Of the trees native to the State of Pennsylvania the Oaks, Chestnut, Buttonwood, Tulip Tree, White Pine, and Hemlock may be regarded as long-lived trees, and the Poplars, Willows, most Birches, and some Cherries as short-lived. Some of the White Oaks found in the original forest of Pennsylvania showed an age of approximately 500 years. Some of the trees of this State reach a great age and enormous size, still none approach such trees as the Big Cypress Tree of Tule found in the state of Oaxaca, Mexico, or the Sequoia of California.

It is not always easy to tell the age of a tree or that of an even-aged stand of trees. Planting records are often very valuable in determining their exact age. The best means of finding out the exact age of a tree is to ask the owner who kept a record when the tree was planted. This method may be used for some ornamental trees and for forest stands which were artificially established. Detailed records should be kept of all forest stands whether established artificially or naturally. The determination of the age of trees in the original forest or in an unregulated forest is a more difficult task. The age of a young tree like that of a child is more readily determined than that of an old tree. The best test for telling the age of a tree, if planting records are wanting, is to count the annual rings on a cross-section of the stem near to the ground and adding to this number, as many years as it took the tree to grow to that height. (Plate I, two lower series of drawings, and Plate XI, 1, 3.) Each ring usually represents the growth of one year. A second test will apply to such trees as White Pine, which develop their lateral branches in distinct and rather regular whorls. (Plate I, upper right figure, and Fig. 16.) Each whorl normally represents a year's growth. If the branches have fallen off one can often find the scars of the branches on the stem. (See Figs. 30 and 31.) The age of young trees or small branches can also be determined by counting the rings of terminal bud-scale scars (Plate I, upper left figure). The portion of the branchlet from the end down to the first ring of bud-scale scars represents the last season's growth while that between the first and second rings represents the next to the last season's growth and so on.

To tell the age of trees may sometimes be difficult but it is usually fascinating. After you have been successful in determining the age of a few trees, you may find yourself questioning the age of others as you walk or drive by them. A careful study of their growth will often indicate the successes and failures which they met during their development, since a relatively narrow ring often indicates a struggle, while a wide ring indicates favorable growth conditions.

WHEN TREES GROW

Every boy and girl knows that trees grow, but few people know exactly when they grow. Most people believe that trees rest during the winter and grow throughout the entire growing season, which comprises from 150 to 200 days in the middle Atlantic states, and in other regions of the country may be greater or less, depending upon the latitude and altitude. It is the popular belief that trees grow continuously from early spring when the leaves begin to come out of the winter buds until the first frost of autumn when they start to exhibit their rich autumnal coloration.

A careful study of this subject has shown without a doubt that this widespread belief is not founded on fact. It is decidedly misleading, for in the latitude of Pennsylvania 90% of the height growth of our native trees is laid on in less than 40 days of spring and early summer.

Not all trees begin to grow at the same time. Some begin very early in spring, while others wait until the days are long and warm. The Wild Black Cherry usually starts about the first of April, while the Tulip Tree, also known as Yellow Poplar, does not begin until the latter part of April, and the Norway Spruce waits until early

May. This difference of time when trees start to grow may not seem strange, but I wonder where there is a boy or girl who knows, and to whom it does not seem strange, that our Sweet Buckeye has completed all its height growth of the entire season by the 10th of May and then has already formed its winter buds in preparation for a long resting period. For eight years I have watched specimens of this tree, and upon examining them on the 10th of May I always find that height growth for the season is finished completely. They will grow no more until the following year. It is indeed strange that this tree, so common throughout the upper Mississippi Valley, makes all of its height growth in about 35 days of early spring.

The time when trees start and stop their growth will naturally vary from place to place, but the popular belief that growth continues until late fall must give way to the bare fact that most height growth takes place in early spring.

An even greater revelation resulted from a careful study of the growth of trees, and that was the fact that the growth of trees does not proceed regularly but is frequently laid on by leaps and bounds. Periods of rest often occur between successive forward thrusts or elongations of the shoot. The rest periods are sometimes long and again they may be short. In this respect trees work in a manner somewhat similar to that of boys, who are willing to have a long rest periods scattered throughout their working hours.

I recall a Chestnut Oak tree that I watched growing a few years ago. It began growth on April 17 and continued rather regularly until May 23. Then it began a rest period of 32 days. On June 24 it started to grow again and continued until July 13. The first installment of growth extended over 36 days, during which the shoot elongated 10 inches, an average of about one-third of an inch per day. Then followed a rest period of 32 days, when the final growth period of 20 days began, during which time the shoot elongated 13.5 inches—an average of one-half inch per day.

DO TREES GROW AT NIGHT?

For many generations boys and girls have been taught that "mighty oaks from little acorns grow." Our fathers have told us repeatedly about the small tree he planted twenty years ago that is 40 feet high, and that he knows of no superior. But it seems strange that from the vast amount of information that is available about trees nothing is mentioned about whether trees grow more during the day or at night.

A few years ago I told a small group of boys about this interesting question. They became interested at once and agreed to help make a study of this feature of tree growth. No time was lost. Plans were immediately made for a careful study of this interesting subject. The first thing we did was to select 100 trees representing about twenty different kinds. Among them were White Pine, Norway Spruce, Wild Black Cherry, Rock Oak, Tulip and White Ash. Each tree was tagged and given a number. The numbering of the trees made it easy to keep records of daily measurements. Each morning at 7:30 and again at 7:30 in the evening the growth of each of the 100 trees was measured and recorded. This meant that each morning and evening about two hours were spent in measuring the trees. All the measurements were recorded in the book that was especially prepared for the study. Every effort was put forth to make the study worth while. It was great training for the boys and gave results which were not only new but really worth while. The study showed the remarkable fact that trees make about 67% of their growth at night and only 33% during the day, that is, they grow about twice as much at night as during the day. The study went a little bit further and showed that the greatest height growth of trees usually occurs late at night and that the least growth takes place in the middle of the afternoon of clear days.

This study was really worth while. It brought forth new facts and interesting information about tree growth, and at the same time gave the boys a real look into nature's way of doing things. Each year a greater number of boys are going to the woods for a vacation. There is no better place for them to rest and to play, but while there it will surely be worth while for them to study the ways of the wild folks and become more intimately acquainted with the work of the trees and other wonderful plants of nature.

HISTORIC TREES OF PENNSYLVANIA

Some trees have a history in story to tell. Under many trees events of Nation-wide and World-wide importance have taken place.

The tree with the best story in Pennsylvania history is the Penn Treaty Elm. It stood at Shackamaxon on the Delaware only a few miles north of Philadelphia. It was a noble tree measuring 24 feet in circumference at the base and had a branch spread of 150 feet. It was under this tree that William Penn met the Indian chiefs in 1682. Many a council among the chiefs of various Indian nations was held under its spreading branches.

The Treaty Elm came into the possession of the ancestors of General Paul Oliver, who discovered that a shoot was springing

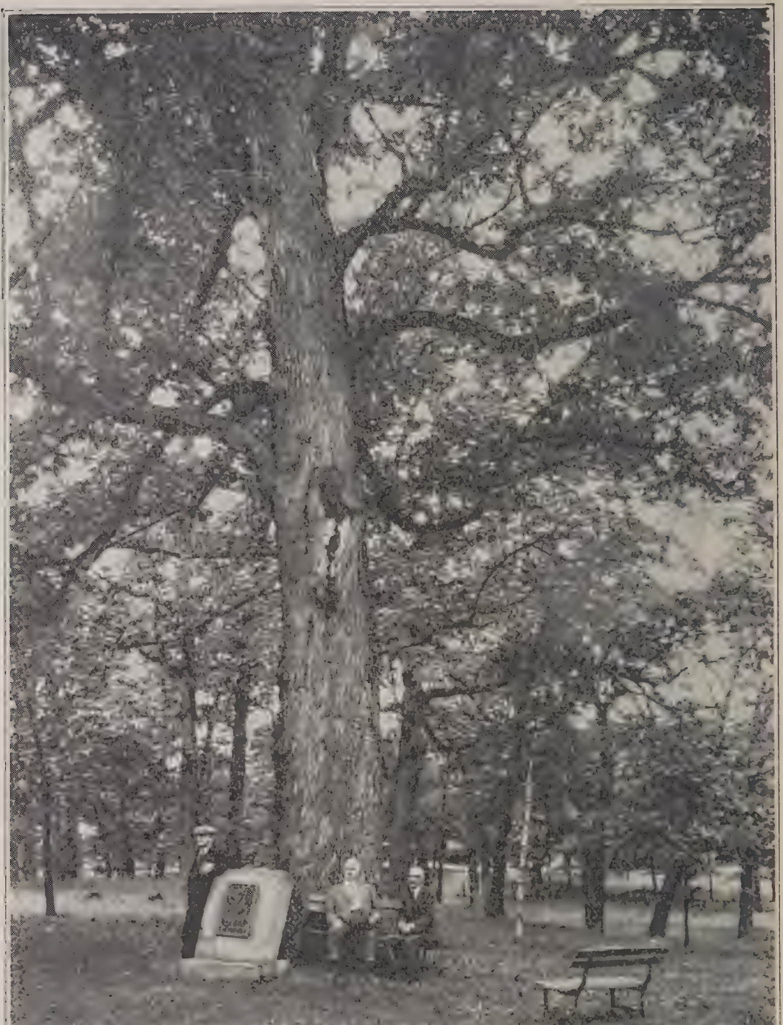

Fig. 45. THE WHITE OAK WITNESS TREE
It stands before the Historic Donegal Presbyterian Church in Lancaster county, Pa.

from the roots of the old tree. He transplanted this shoot to Bay Ridge, New York where it flourished for about 50 years. When it had grown to be a medium-sized tree, General Oliver transplanted the whole tree to his home near Wilkes-Barre, Pennsylvania, where it still stands before the town chapel. On April 10, 1896 a shoot from the General Oliver tree was planted on the campus of the University of Pennsylvania by Governor Hastings in honor of William Penn, the first Governor of the Commonwealth. This tiny tree has grown into a healthy tree of stately proportions. It has rounded out its first quarter of a century and promises to become a worthy off-spring of the famous Penn Treaty Elm.

Other scions of this historic tree stand at the Pennsylvania Hospital in Philadelphia, another in the yard of the Friends' Meeting House on 12th Street, in Philadelphia and still another on the Haverford College Campus. The grandson of the famous Penn Treaty Elm that is on the Haverford College Campus stands immediately in front of the main building. This tree was presented to the college by Joshua Baily, at one time head of the J. L. Baily Cloth Manufacturing Company, Philadelphia. On April 11, 1923 this tree had a breast-high circumference of 9.6 feet, a height of 80 feet and a branch spread of 100 feet.

Another grandson of the Penn Treaty Elm stands on the campus of the Westtown School, about four miles east of West Chester. This tree was planted by Dr. Wills. It is now 48 feet in height and 15.5 inches in diameter.

Seven greatgrandsons of the Penn Treaty Elm are growing on the Haverford College Campus about 250 feet southeast of Robert's Hall. These trees were developed from cuttings taken from the grandson of the Penn Treaty Elm also on the Haverford campus. In 1916 the late Mr. Wystar, a Haverford alumnus, presented these historic trees to the college. In giving seven trees for planting he followed an old English custom of planting seven trees of the same species in a group. These seven trees now range in diameter from 1.8 to 4 inches and their height ranges from 12 to 21 feet.

There are other historic trees in the State. Among them is a White Oak standing near the historic Donegal Presbyterian church, between Marietta and Mount Joy in Lancaster County. It is known as "The Witness Tree." This magnificent White Oak stands out in grandeur and loveliness among all its associates. Almost 150 years ago an impressive expression of National patriotism took place under this stately tree that was then already past middle age. At its base is a tablet that gives the record of the historic event that took place beneath its mighty branches. The tablet reads:

"Beneath this witness tree a new patriotism found notable expression on a Sunday morning in September 1777. An express rider came to tell the congregation of Donegal church that the British army, under Lord Howe had left New York to invade Pennsylvania. This news demanded from all a new attitude towards the facts which challenged them to show proof of their patriotism. Their pastor, Rev. Colin McFarquhar, had been accustomed to offer prayers for the King of England. Pastor and congregation joined hands under its shade and pledged their loyalty to the cause of liberty and the founding of a new nation in this Western World".

This historic White Oak is one of the grandest in the State. It is a veteran of more than 300 years and it may live for 100 years or more. A pilgrimage to it is worth while.

Another historic tree is the Lafayette Sycamore. It stands on a hill about 200 yards east of the Brandywine Baptist church, near Chadds Ford, Delaware County. Its branches over-hang the stone house occupied by General Lafayette for headquarter purposes before the battle of Brandywine, September 10-11, 1777. Historians tell us that Lafayette was laid under this tree after being wounded. Local reports inform us that he tied his horse to this tree on the evening before the battle.

It is now a massive tree measuring almost 20 feet in circumference breast-high. At the ground it is over 25 feet in circumference. It is very accessible for observation and study, for it stands less than 100 yards from the Baltimore pike.

There are other historic trees in Pennsylvania. Not all of them can be listed here. Undoubtedly there are many whose records are not yet fully known. The Department of Forestry is anxious to compile full information about all the historic trees of the State. If the readers of this book know of a Pennsylvania tree that has a story in history to tell, they will do a good turn by sending a full history of it to the Department of Forestry. It is quite probable that some day a book will be published on the "Historic Trees of Pennsylvania."

PENNSYLVANIA'S MOST UNIQUE TREE

What is probably the most unique tree in Pennsylvania is a Prostrate Juniper. It is growing in the woodlot owned by the late Christian Schenk, located in Conewago Township, Dauphin County. This tree is also called "trailing juniper," because of its trailing habit of growth. The tree has an average spread of 45 feet and averages only 3 feet in height. It is indeed unique in that it is 15 times as wide as high and covers just about 2,000 square feet. Its estimated age is 165 years.

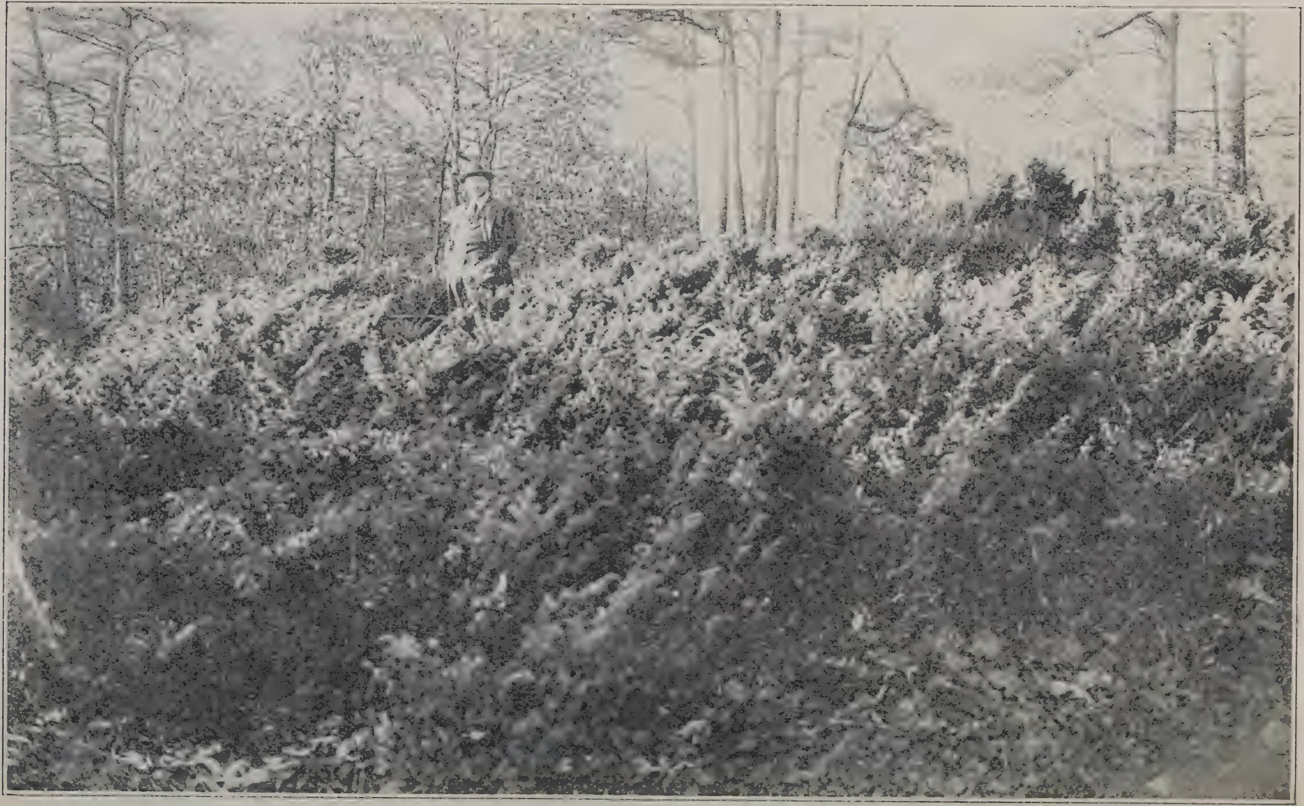

Fig. 46. PENNSYLVANIA'S MOST UNIQUE TREE.
It is a Prostrate Juniper in Dauphin county.

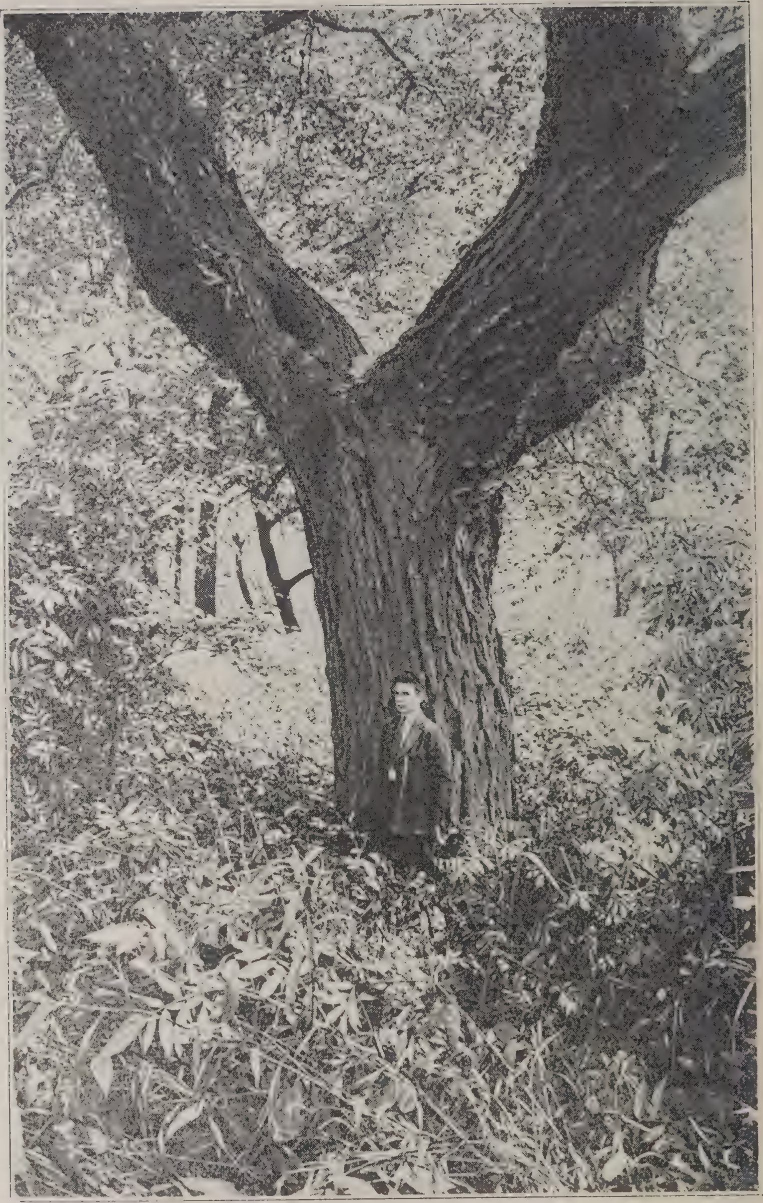

Fig. 47 THE LARGEST RIVER OR RED BIRCH IN PENNSYLVANIA STANDS ALONG THE WEST BRANCH OF THE SUSQUEHANNA IN CLINTON COUNTY

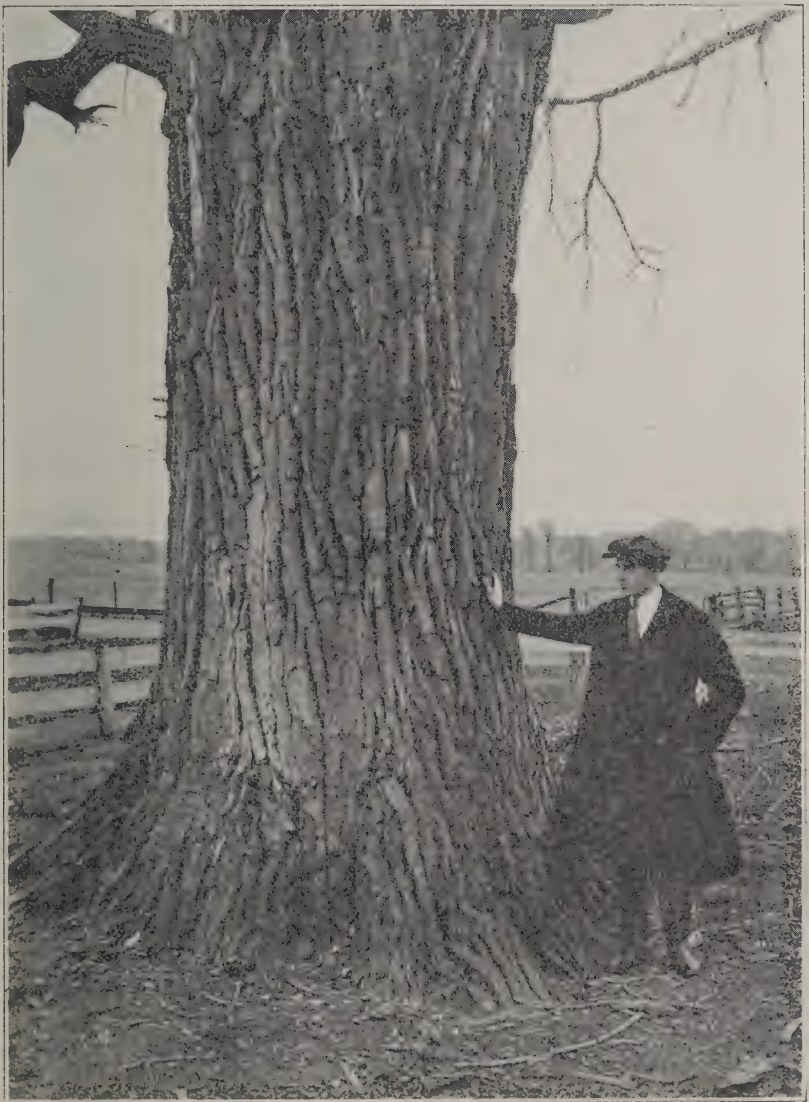

Fig. 48. THE LARGEST COTTONWOOD IN PENNSYLVANIA
It is over 22 feet in circumference breast-high, 82 feet high, and has a branch spread of 90 feet

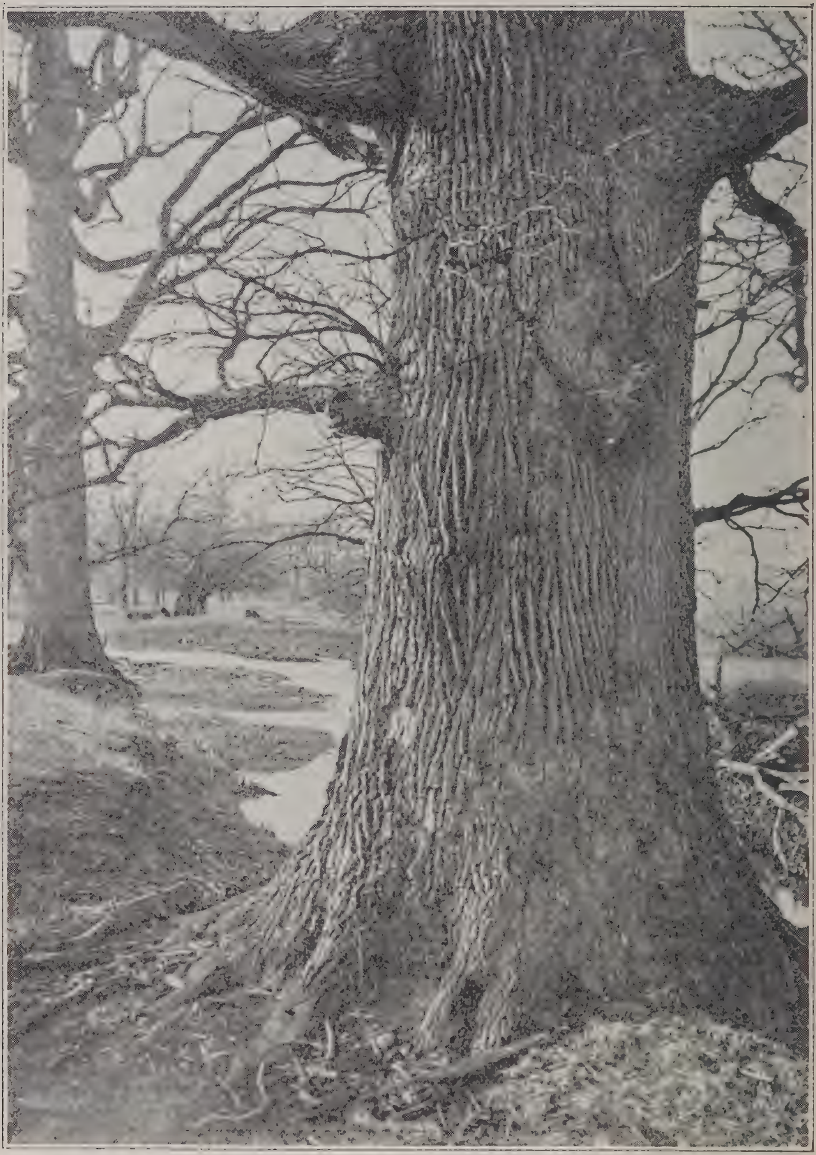

Fig. 49. A VETERAN PENNSYLVANIA BURR OAK
It is 18 feet in circumference at breast-height. Stands in the southwestern part of Franklin county

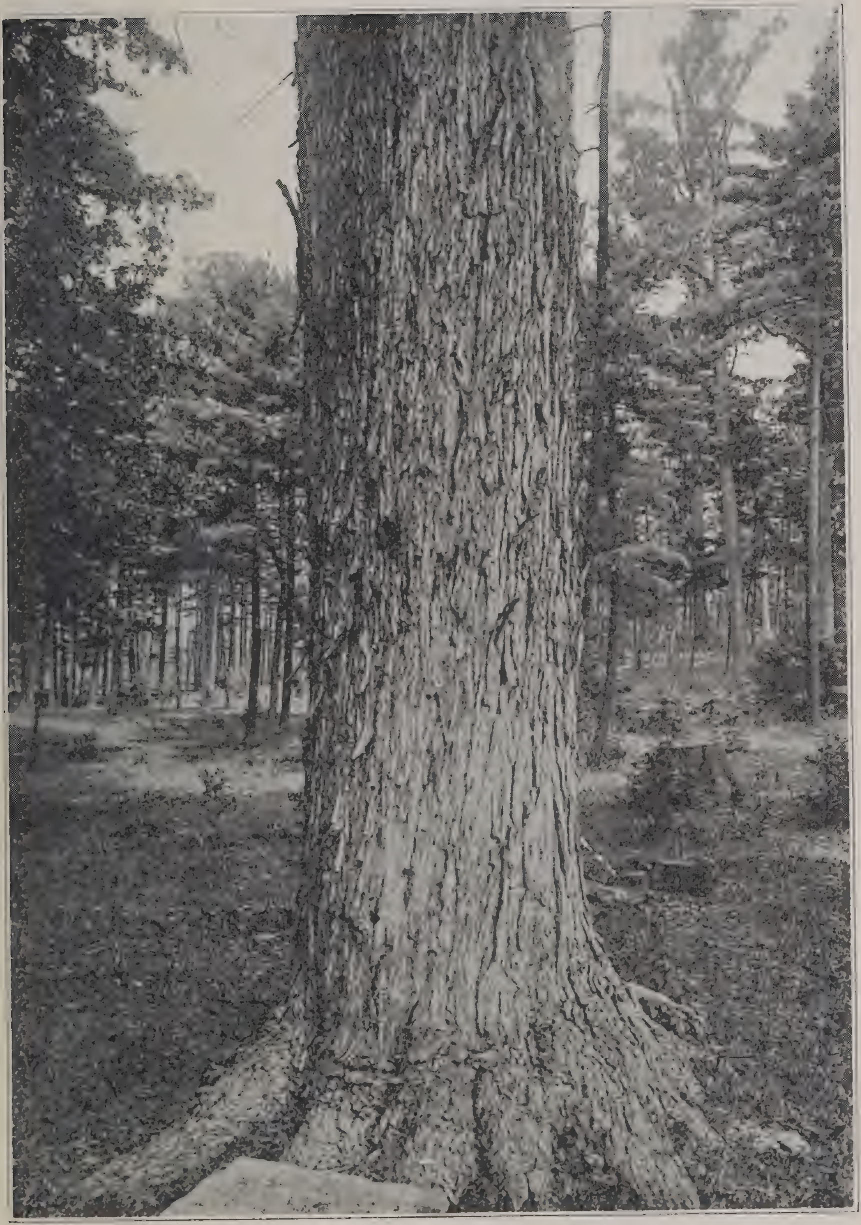

Fig. 50. THE LARGEST RED MAPLE IN PENNSYLVANIA.
It is over 4 feet in diameter and clear of branches for 40 feet from the ground. Stands near Coburn in Centre county

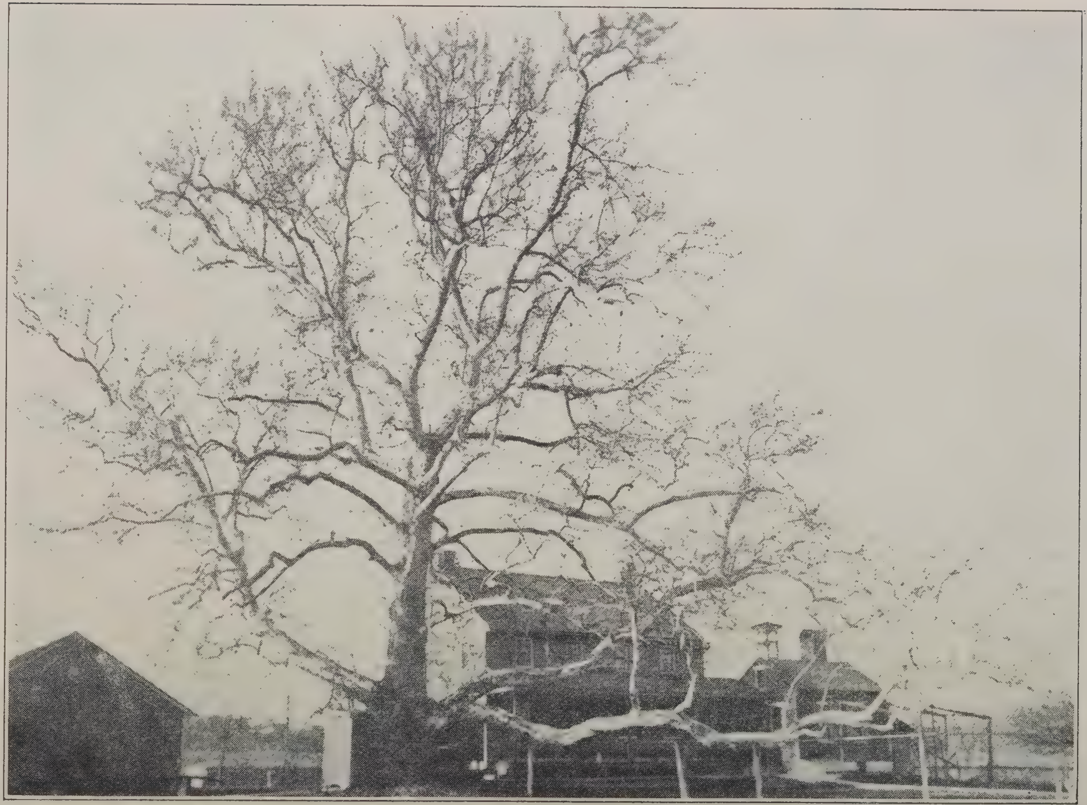

Fig. 51. PENNSYLVANIA'S MOST MASSIVE TREE
It is a Sycamore standing 4 miles west of the City of Lancaster

The people who live in the vicinity of the tree call it the "green tree" for it is a green tree and stands in strong contrast to all other trees in the neighborhood. In fact there is no other tree exactly like it in Pennsylvania. It is a variety of the Common Juniper which varies from an extremely erect to a decidedly prostrate habit. The erect form is usually called "Irish Juniper" and the prostrate form is the "Prostrate Juniper."

A large number of cuttings have been taken from the Prostrate Juniper of Dauphin County. Many of them have developed into thrifty young trees. About 100 are thriving at the Masonic Homes at Elizabethtown in Lancaster County. No seeds have ever been found on the parent tree and consequently, the only way to produce it has been by the cutting method.

The Prostrate Juniper is a native of the northwoods. One meets it in northern Europe and in Siberia and it occurs rather commonly in Canada. It is also found in a few localities about the Great Lakes and in New England. The Dauphin County specimen is the most southern outpost of this unique tree. It is thought that a wild pigeon or some other migatory bird carried the seed from the northwoods and deposited it in Dauphin County where it has developed into Pennsylvania's most unique tree.

The Boy Scouts of Elizabethtown serve as custodians of this unique tree. They have posted signs requesting all visitors to help protect the tree. It is a natural object worthy of protection and every effort should be put forth to protect it from unnecessary damage. If well protected, it may live many more years.

PENNSYLVANIA'S MOST MASSIVE TREE

What is believed to be the most massive tree in Pennsylvania is a Sycamore or Buttonwood that stands about four miles south of Lancaster between the Lincoln Highway and the Marietta turnpike. It has a circumference of 27 feet and 6 inches, at 18 inches above the ground and at five feet above the ground it is over 22 feet in circumference. The tree has a height of 102 feet and its branch spread from east to west is 118 feet and from north to south 138 feet.

It has three main branches. They are 70, 72, and 84 feet long respectively. All three of these branches are fully as large as any an averaged sized tree. One of them is more than nine feet in circumference at 18 inches from the stem and reaches out horizontally for 40 feet where it is only six feet from the ground and sweeps upward for more than 30 feet.

This is truly a wonderful tree. It is unquestionably more than two centuries old and stands out as a veteran among all the other trees of the neighborhood.

THE LARGEST SEQUOIA IN EASTERN NORTH AMERICA

The Big Trees of California, also known as Redwoods and Sequoias are among the best known trees of North America. Few people know that a thrifty specimen of this wonderful tree is growing in Pennsylvania. It stands along the fence at the Painter Arboretum, near Lima, Delaware County and has attained a height of 50 feet. It is 26 inches in diameter at breast-high and promises to live long.

Tree experts say that it seems remarkable that this tree does so well in southeastern Pennsylvania. Every effort should be put forth to protect it. It may never reach the size of the Sequoias of California, some of which are 30 feet in diameter and over 4,000 years old, but it does promise to develop into a big and wonderful tree. An appropriate out-door exercise for near-by schools is to visit this rare tree, which is the largest of its kind in eastern North America.

THE FORM AND STRUCTURE OF TREES

1. FORM:

By form is meant the general appearance of a tree. One can study the form of deciduous or broad-leaved trees best in winter when they are devoid of their foliage. After one is familiar with the general form of different trees it is possible to distinguish kinds even at a great distance. The form, together with the color and figure of the bark, is a character by which many of our trees may be accurately distinguished. The form of trees varies with the species, the environment, and the sylvicultural treatment.

Some trees attain an enormous size and great age while others never become large or old. The Sequoias of California, also known as Redwoods and Big Trees, and the Cypress trees of Mexico have representatives which are regarded the largest and oldest in existence. A section of a Big Tree now in the American Museum of Natural History in New York City shows that the tree when cut was 1,341 years old. It was 90 feet in circumference at the base, over 350 feet in height, and estimated by lumberman to contain 400,000 board feet of lumber. Probably the largest Cypress in the world stands in a churchyard about five miles from the City of Oaxaca, in Mexico. This tree has a circumference, according to recent measurements, of 154 feet 2 inches, 6 feet above the ground. It is about 125 feet high and, according to various estimators, can scarcely be less than 4,000 years old, and may possibly be over 5,000 years.

Specimens of this large size and great age have never been found in the State of Pennsylvania. Some of our native trees, the Chestnut, White Oak, Red Oak, Tulip Tree, Hemlock, and White Pine

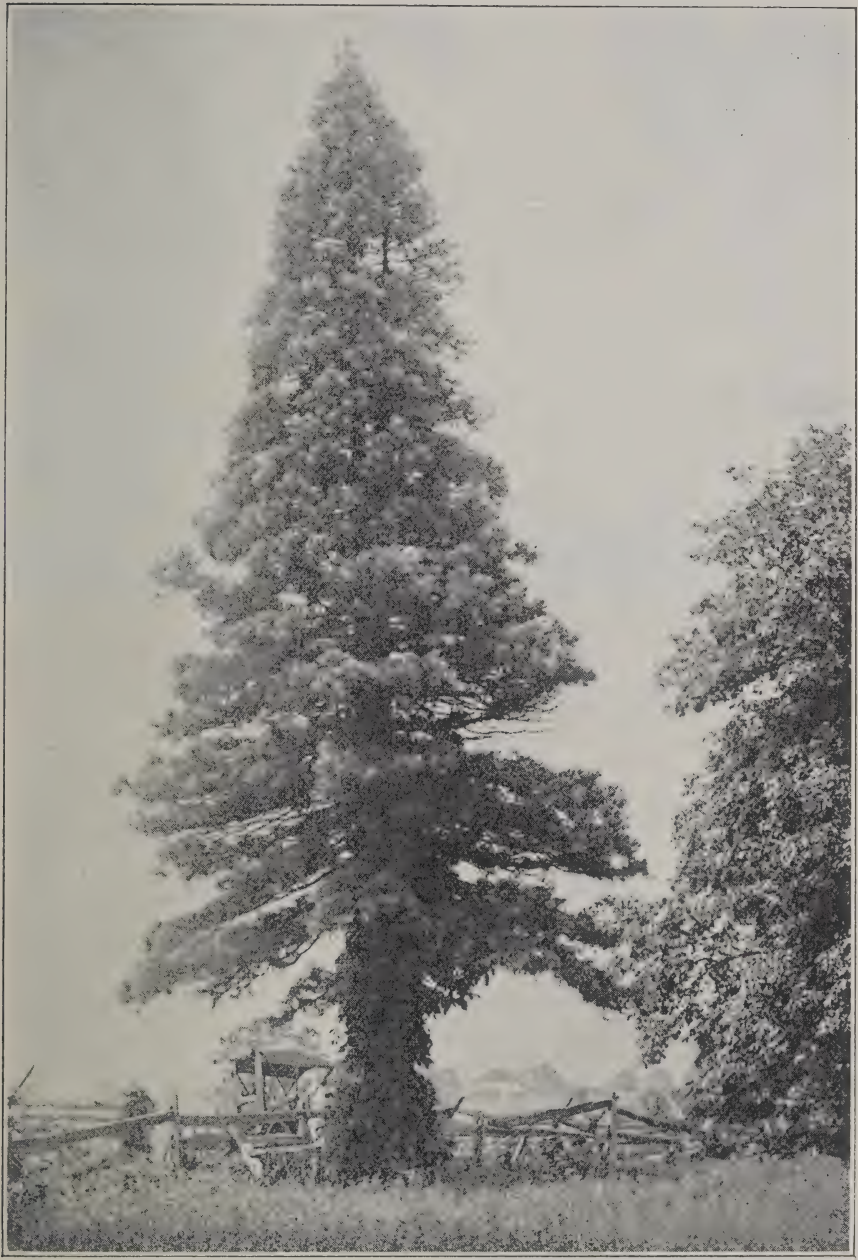

Fig. 52. THE LARGEST SEQUOIA IN EASTERN NORTH AMERICA.
It stands along a fence near Lima, Chester county, Pa.

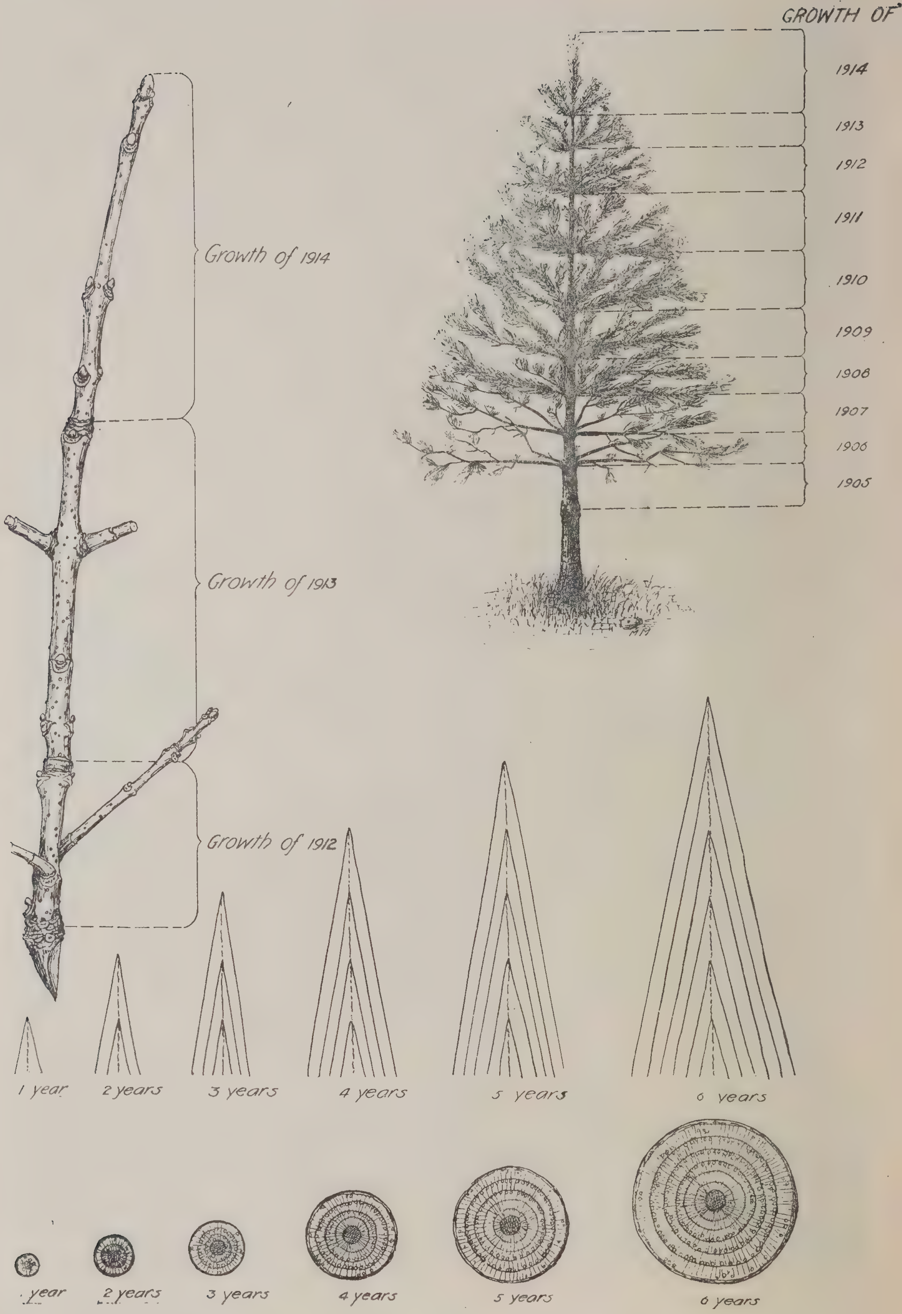
GROWTH OF
1914
1913
1912
1911
1910
1909
1908
1907
1906
1905
Growth of 1914
Growth of 1913
Growth of 1912
1 year
2 years
3 years
4 years
5 years
6 years
year
2 years
3 years
4 years
5 years
6 years

PLATE I. THE AGE OF TREES

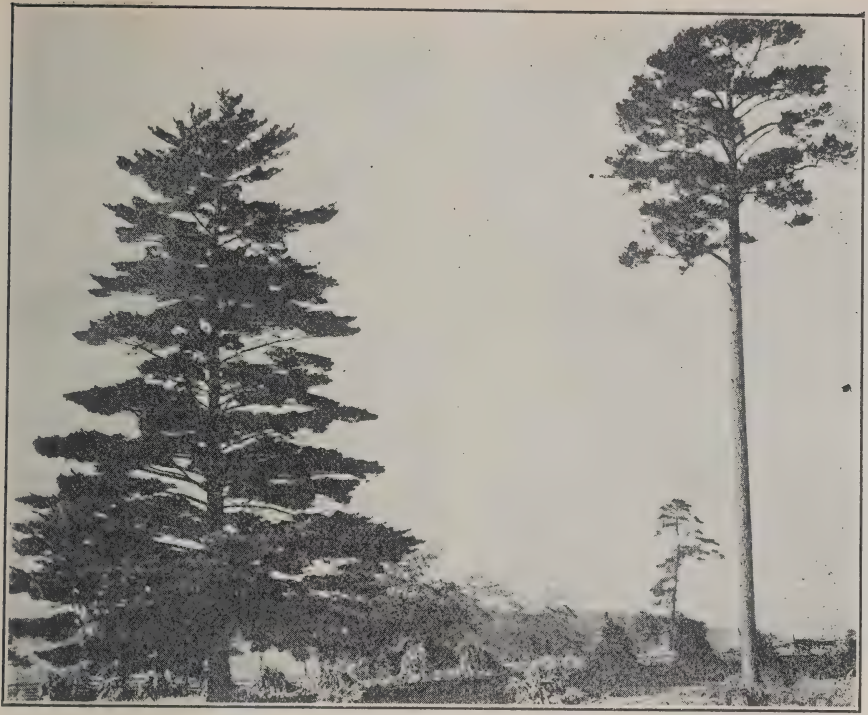

Fig. 53. OPEN-GROWN PINES

White Pine on left, Yellow Pine on right. Both trunks developed in same environment. Difference of form is due to inherent qualities. One tapers, with persistent lateral branches; the other with little taper and few branches

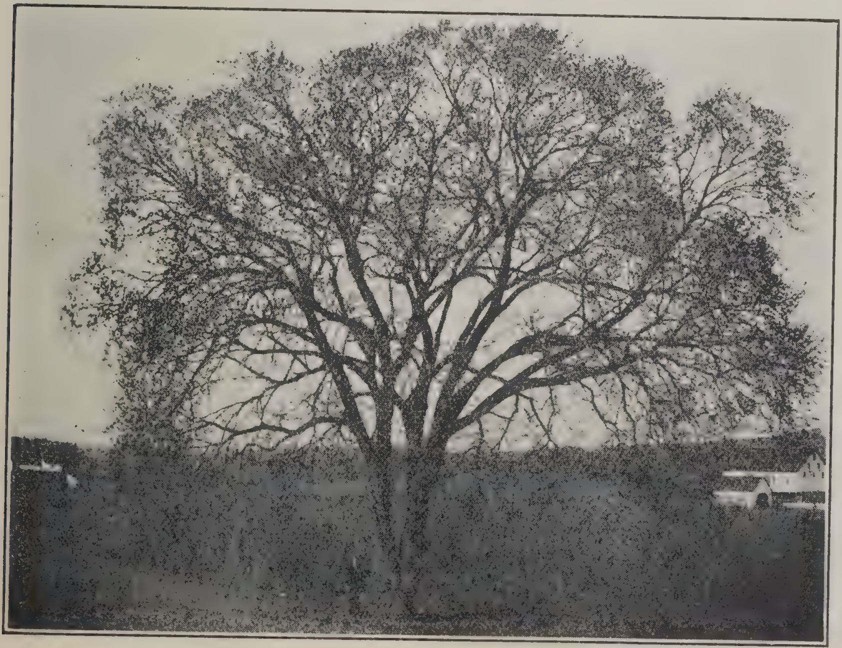

Fig. 54. OPEN-GROWN AMERICAN ELM

Its trunk branches near the base and then repeatedly subdivides. Such a trunk is known as a deliquescent trunk

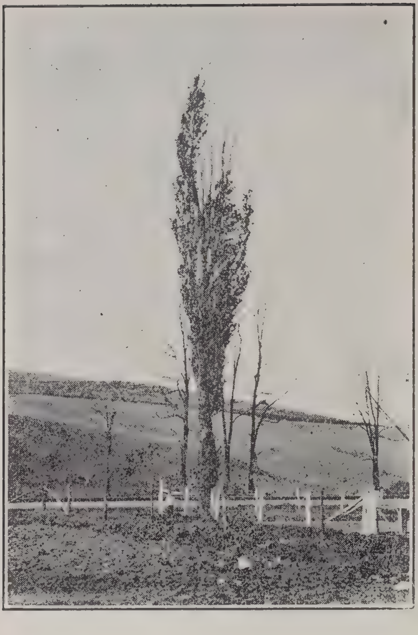

Fig. 55. FORM OF LOMBARDY POPLAR

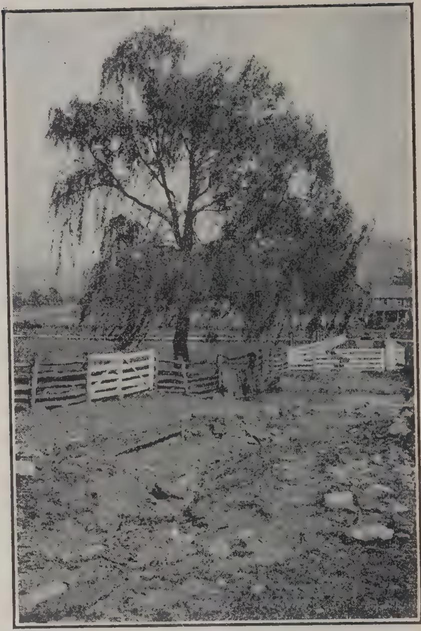

Fig. 56. FORM OF WEEPING WILLOW

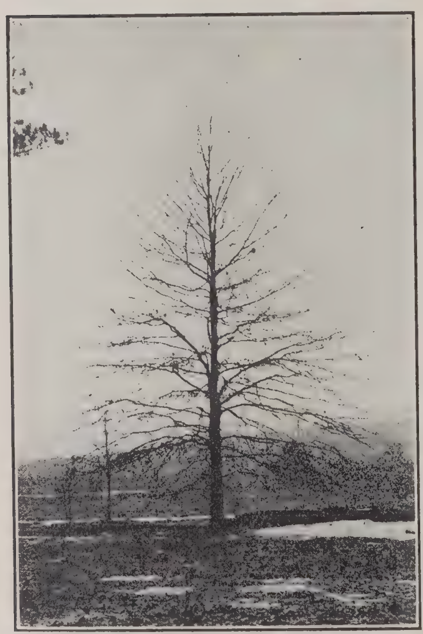

Fig 57. FORM OF A YOUNG PIN OAK

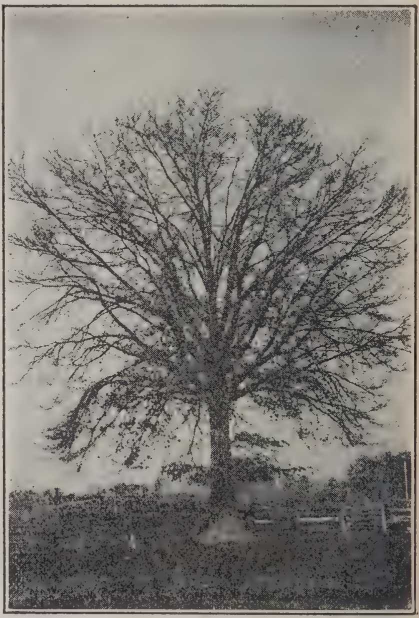

Fig. 58. FORM OF AN OLD PIN OAK

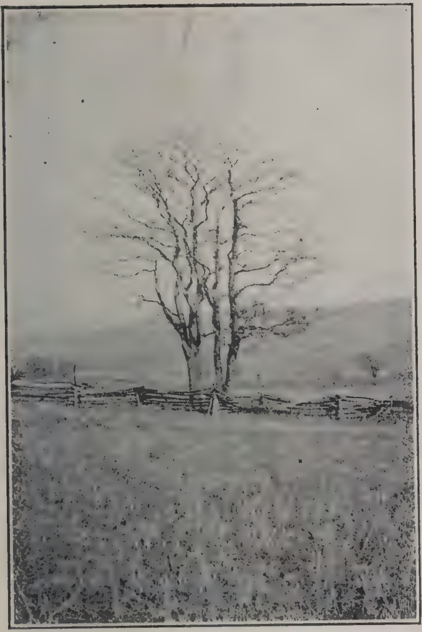

Fig. 59. FORM OF A SASSAFRAS

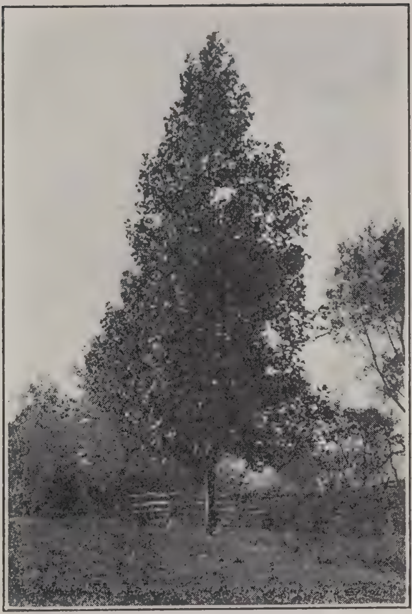

Fig. 60. FORM OF A YOUNG OPEN-GROWN TULIP TREE

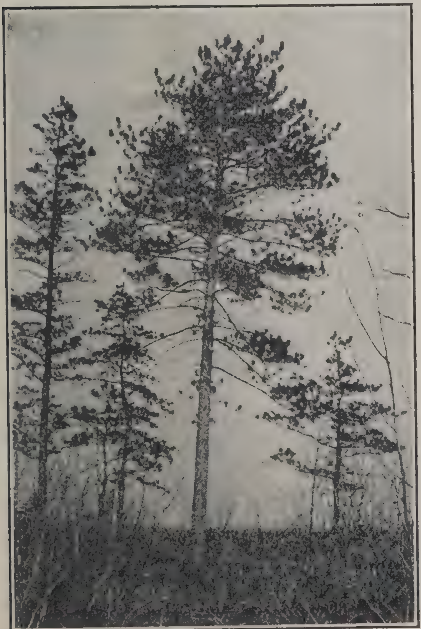

Fig. 61. FORM OF A RED PINE

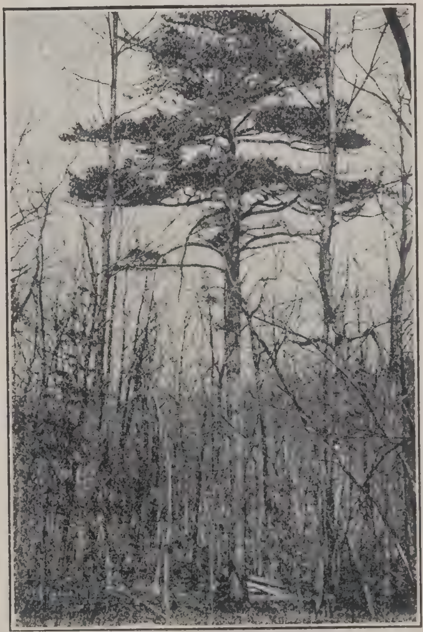

Fig. 62. FORM OF A TABLE MOUNTAIN PINE

It developed in a closed stand. Diameter 22 inches

have, however, attained great size. A few large specimens which were cut in recent years, showed by count of their annual rings that they had started life before Columbus discovered America. In Forest Leaves, Vol. IX, No. 10, Dr. J. T. Rothrock describes a White Oak standing near Kutztown, Berks county. It was 31 feet in circumference at the level of the ground and had a spread of branches of 104 feet and an estimated height of almost 74 feet. This tree was probably the largest White Oak in Pennsylvania. During a storm on March 20, 1923 this forest monarch was blown over. Larger specimens of Chestnut have been found in this State.

The largest Chestnut tree on record had a diameter of 17 feet. It was found near Waynesville, North Carolina. Other species like the Scrub Oak (Fig. 4), Gray Birch (Fig. 83 and 88), and Scrub Pine never become large. Some trees may remain small in one region and yet become large in another. The Chinquapin, which reaches its nothern limit is Pennsylvania seldom exceeds a height of 10 feet in this State while it reaches a height of 50 feet in southern Arkansas.

The character of the stem, to a large extent, determines the form of the tree. The main axis of a tree usually grows erect. The lateral branches vary according to the species and the position of neighboring branches. In some trees like the Weeping Willow (Fig. 56) they are drooping, in others like the Black Gum and Pin Oak (Fig. 57) they are horizontal, while those of the Lombardy Poplar are ascending (Fig. 55). If the terminal shooot is removed or killed a lateral branch in time may take its place. Sometimes two lateral branches strive for the leadership but they are such close competitors that neither can win out. The result is a "stag-headed" tree. Again a dormant bud may be stimulated into activity with the result that no lateral branch obtains the leadership. After studying these growth forms, one is inclined to think that the terminal shoot prevents the erect growth of the lateral branches.

Environment has a marked influence. The form of a tree growing on an exposed mountain top differs very much from one growing on sheltered bottomland. An open-grown tree has a form entirely different from one grown in dense forest stand. The form of open grown specimens varies with the species. Two different kinds of Pine shown in Fig. 53 grew side by side in the same environment and still developed entirely different crowns. Open-grown trees usually branch near the ground and have a broad, deep, symmetrical crown, while trees grown in dense forest stands usually branch farther from the ground and have a long clean trunk with a shallow and often irregular and unsymmetrical crown. Trees grown in a dense stand may not be so attractive as those grown in the open but they yield a much higher grade of wood, since the lateral branches which produce many of the knots in lumber are removed early in the life history of the tree. The density of the forest stand should be so regulated that on every acre of soil not only the greater quanity but also the best quality of wood is produced.

Two kinds of branching are usually recognized, the *excurrent* or upright and the *deliquescent* or spreading. When the main trunk is continuous and extends upward to the tip without dividing it is known as excurrent, and when the main trunk is not continuous but divides and subdivides into more or less equal parts it is known as deliquescent. Most of our evergreen species have the excurrent type of branching, while most of our deciduous trees have the deliquescent type. A few of the latter, as the Pin Oak, Tulip Tree, and Buttonwood, often show an excurrent or upright tendency in the form of their trunk, especially when young.

2. BARK:

If we examine the growing point of a seeding we will find that there is very little difference among the parts composing it. Soon, as a result of growth, various kinds of tissue will be formed. At the end of its first growing season we can differentiate roots, stem, and leaves. The stem is still further distinguished into pith, wood, and bark (Plate XI, 1). Nature seems to know that the vital elements in the stem need protection. This protection is given by the bark.

Bark is that portion of the stem which lies outside of the cambium layer. It consists of an outer and an inner bark. The former is commonly known as the outer or dry bark and functions primarily as a protective covering while the latter is known as the inner or living bark and helps to convey the food which was manufactured in the leaves to various parts of the stem. The thickness of the bark is often determined by the rapidity with which it peels off. Its thickness, together with its larger number of dead, air-containing cells, makes it a very effective protective covering; but the chief protective feature of bark is the formation of corky layers. The chief function of the protective covering plants is the prevention of excessive transpiration. The regular cork formations in the bark help very much in controlling transpiration. Cork is one of the most valuable elements of the bark. Its structure is complex and variable. Cork is impermeable to air and water, a poor conductor of heat, and a preventer of penetration by parasites. Local out-growths of cork like the wings of the Sweet Gum and Hackberry are probably of no value to the plants producing them. In some species the bark is not fully "ripened" at the end of the growing season, consequently the subjacent tissues do not have the necessary protection and frequently die back during the winter. The color of the bark

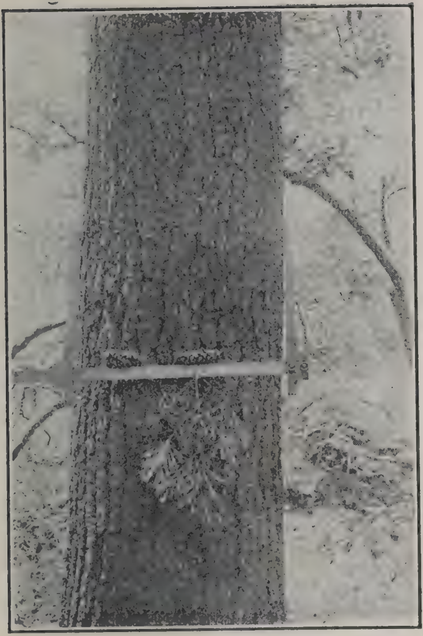

Fig. 63. WHITE PINE
Trunk 25 inches in diameter

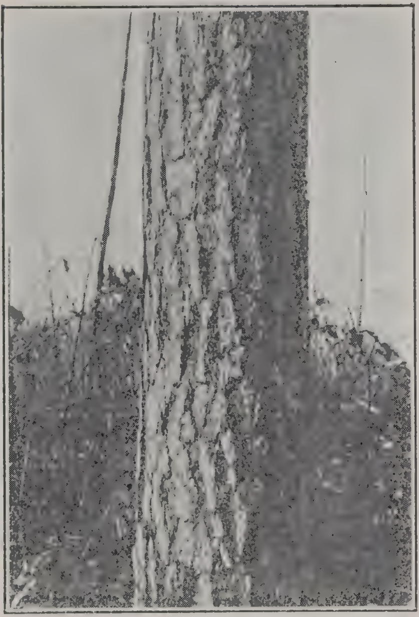

Fig. 64. RED PINE
Trunk 20 inches in diameter

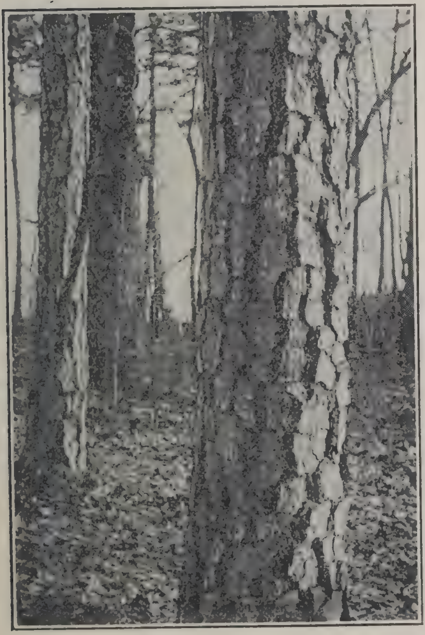

Fig. 65. PITCH PINE
Trunk 22 inches in diameter

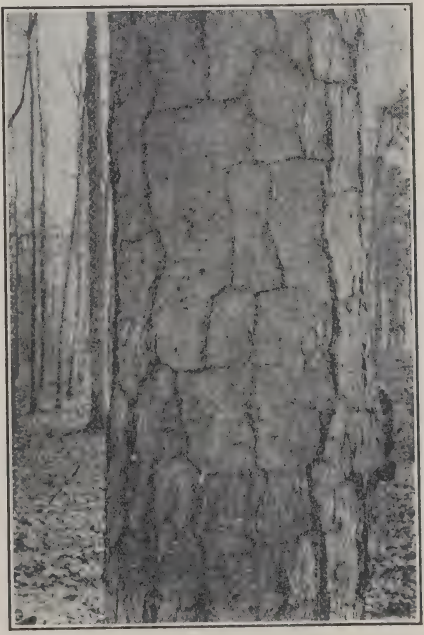

Fig. 66. YELLOW PINE
Trunk 29 inches in diameter

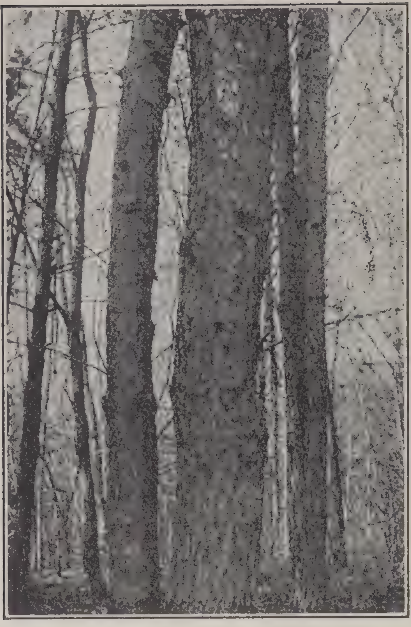

Fig. 67. JERSEY OR SCRUB PINE
Trunks 7 and 14 inches in diameter

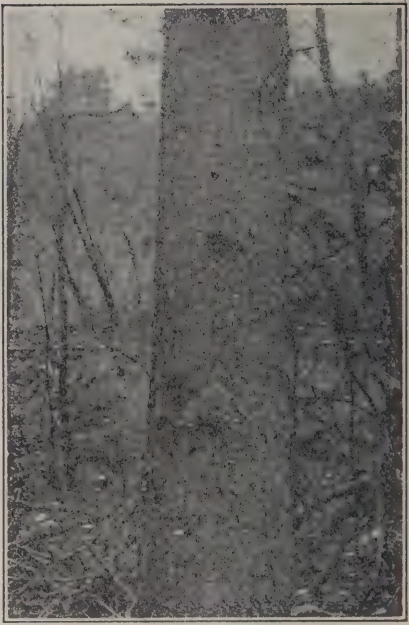

Fig. 68. AMERICAN LARCH
Trunk 18 inches in diameter

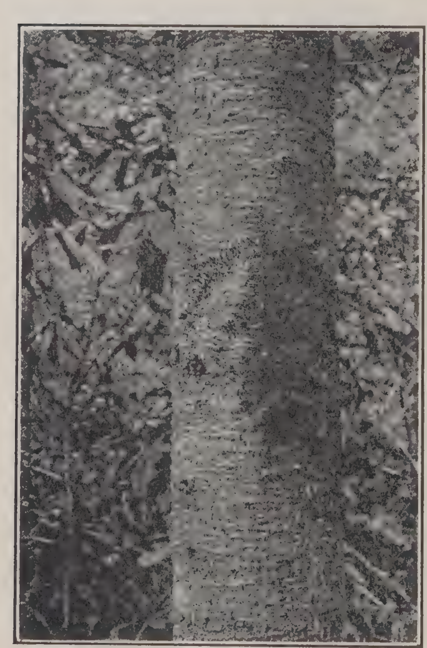

Fig. 69. BALSAM FIR
Trunk 16 inches in diameter

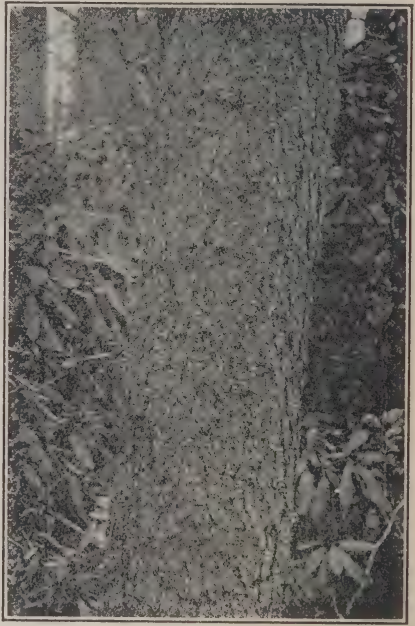

Fig. 70. BLACK SPRUCE
Trunk 14 inches in diameter

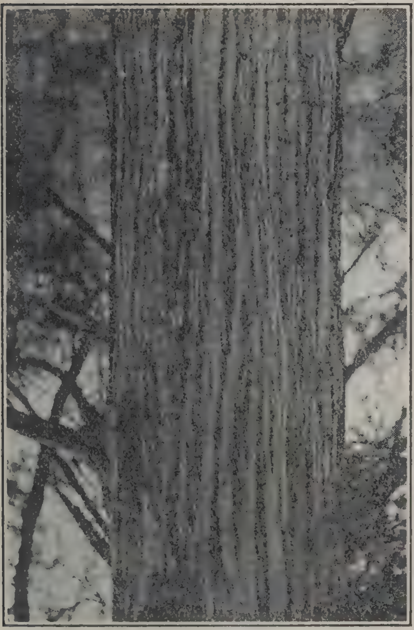

Fig. 71. RED CEDAR
Trunk 24 inches in diameter

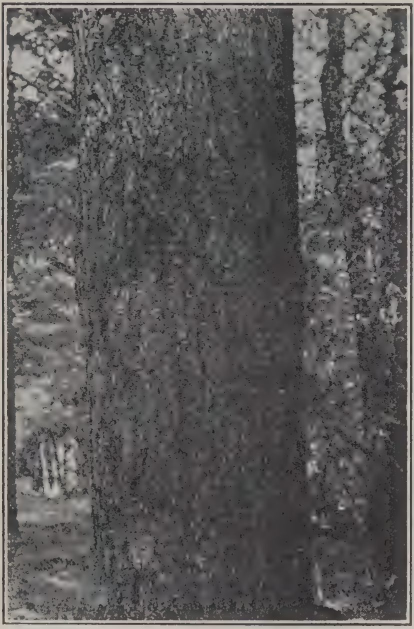

Fig. 72. HEMLOCK
Trunk 22 inches in diameter

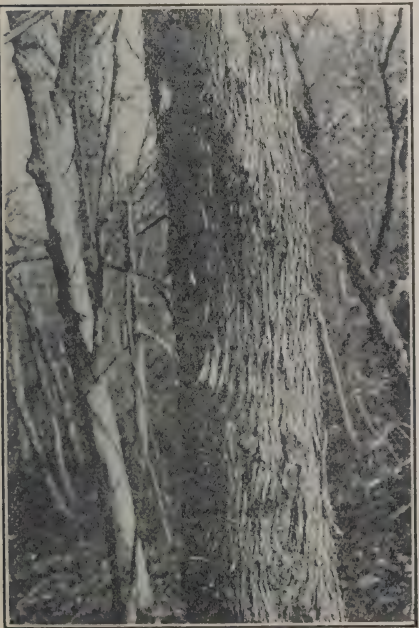

Fig. 73. AMERICAN HOP HORN-BEAM
Trunk 18 inches in diameter

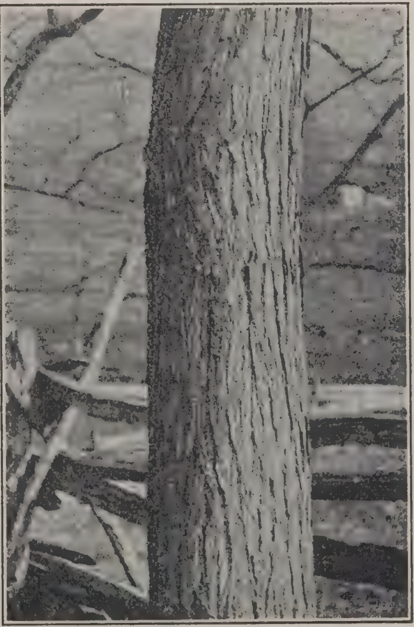

Fig. 74. RED MULBERRY
Trunk 17 inches in diameter

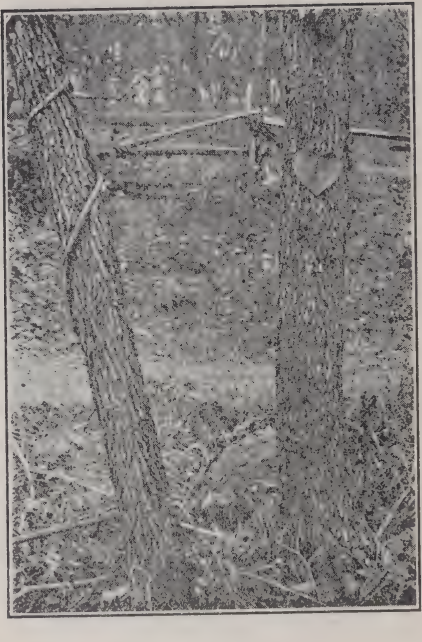

Fig. 75. REDBUD
Trunk 8 inches in diameter

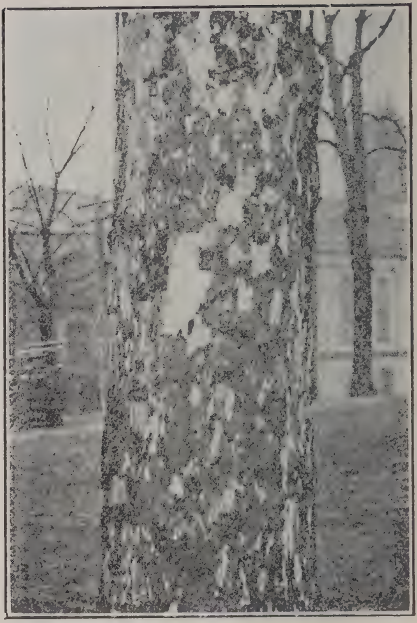

Fig. 76. BUTTONWOOD
Trunk 18 inches in diameter

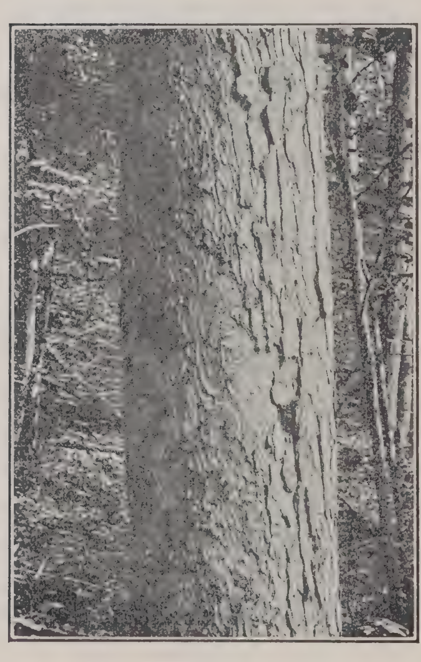

Fig. 77. SWEET BUCKEYE
Trunk 32 inches in diameter

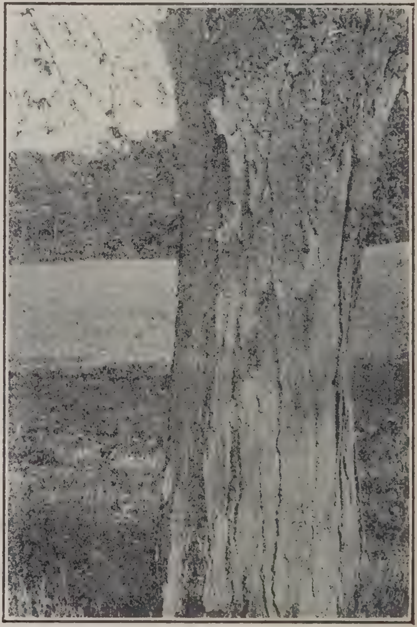

Fig. 78. HONEY LOCUST
Trunk 30 inches in diameter

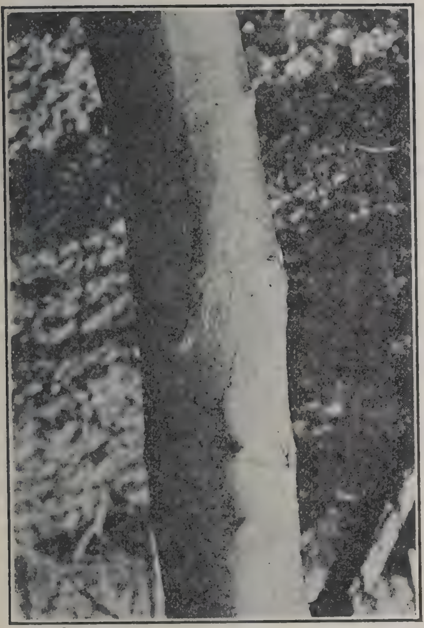

Fig. 79. RED MAPLE
Trunk 8 inches in diameter

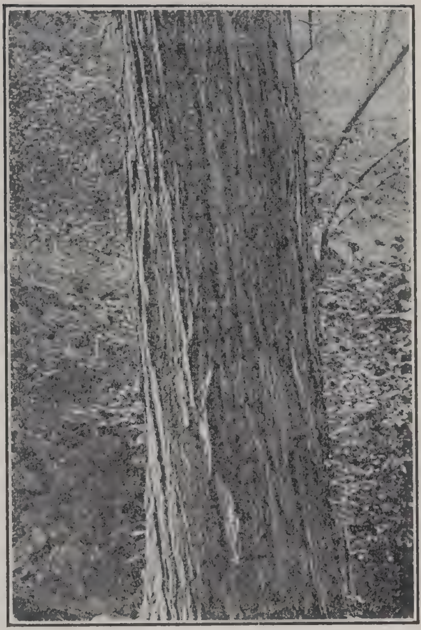

Fig. 80. RED MAPLE
Trunk 30 inches in diameter

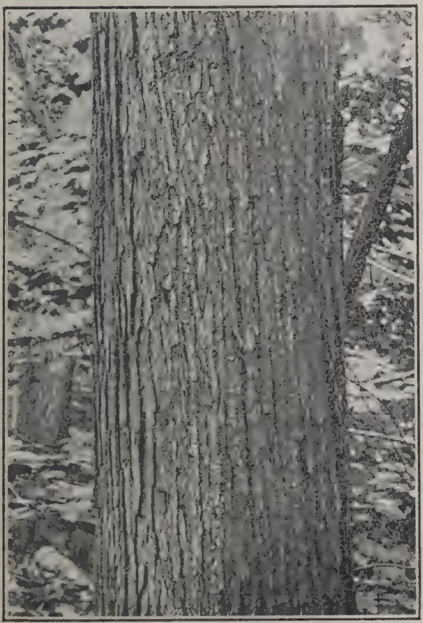

Fig. 81. SUGAR MAPLE
Trunk 32 inches in diameter

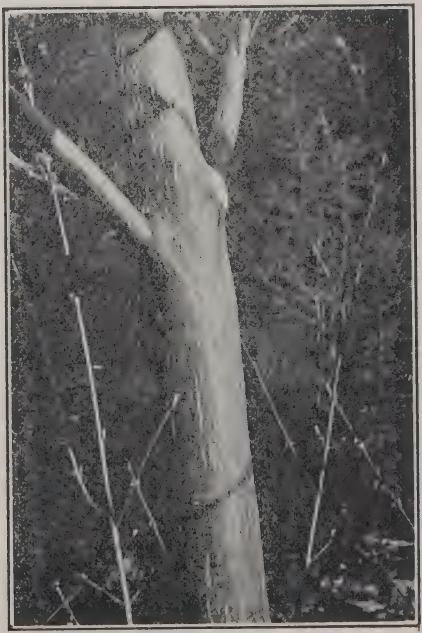

Fig. 82. STRIPED MAPLE
Trunk 4 inches in diameter

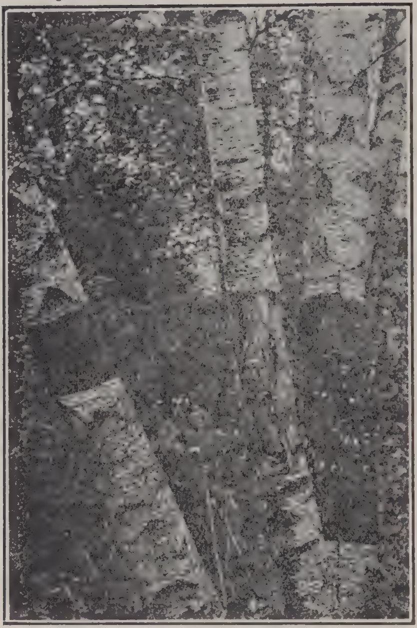

Fig. 83. GRAY BIRCH
Trunks 4-9 inches in diameter

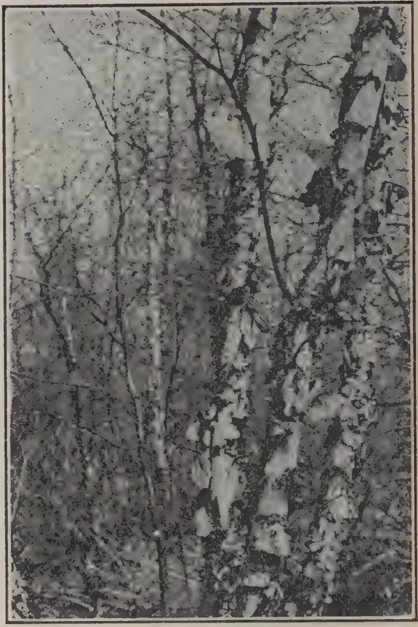

Fig. 84. RIVER BIRCH
Trunks 6 inches in diameter

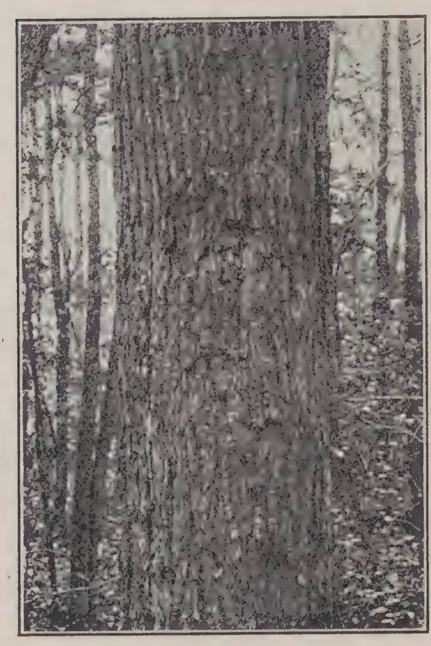

Fig. 85. SLIPPERY ELM
Trunk 26 inches in diameter

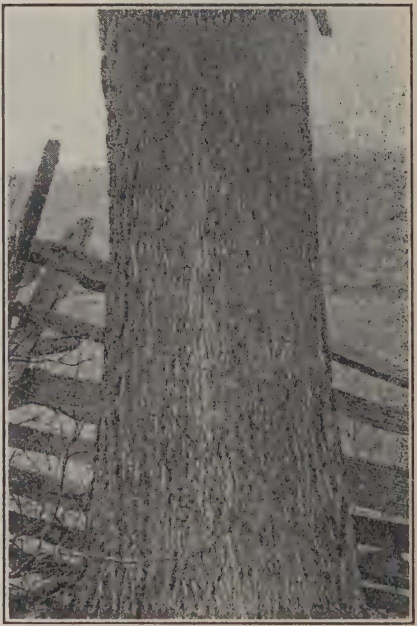

Fig. 86. SASSAFRAS
Trunk 26 inches in diameter

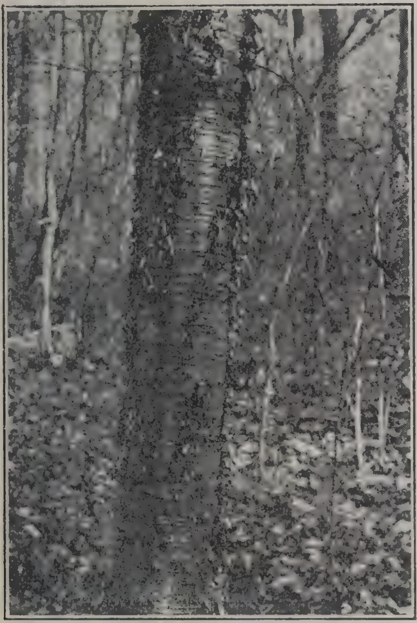

Fig. 87. YELLOW BIRCH
Trunk 8 inches in diameter

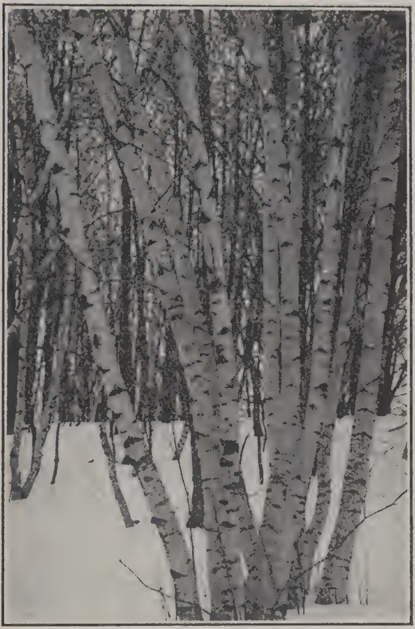

Fig. 88. GRAY BIRCH
Trunk 4 inches in diameter

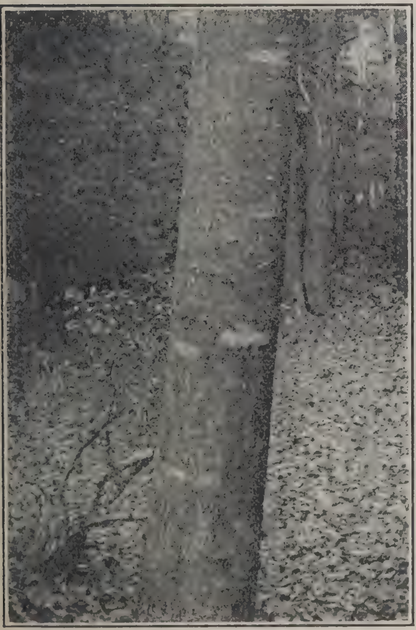

Fig. 89. BLACK BIRCH (Young)
Trunk 7 inches in diameter

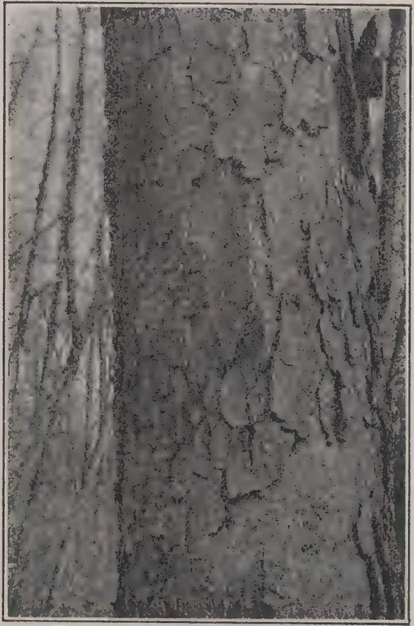

Fig. 90. BLACK BIRCH (Old)
Trunk 27 inches in diameter

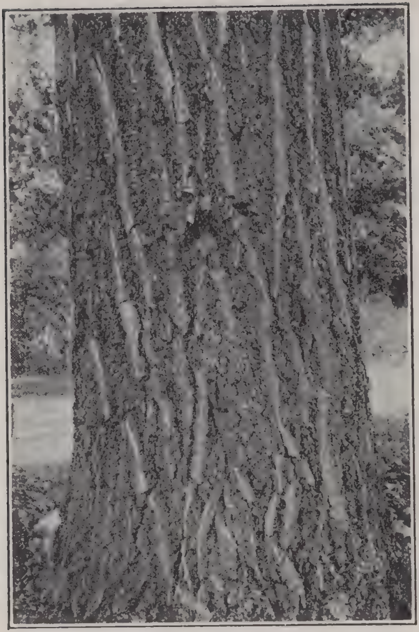

Fig. 91. RED OAK
Trunk 46 inches in diameter

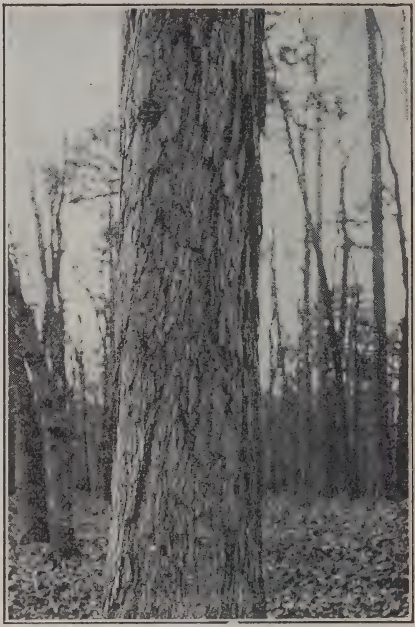

Fig. 92. WHITE OAK
Trunk 30 inches in diameter

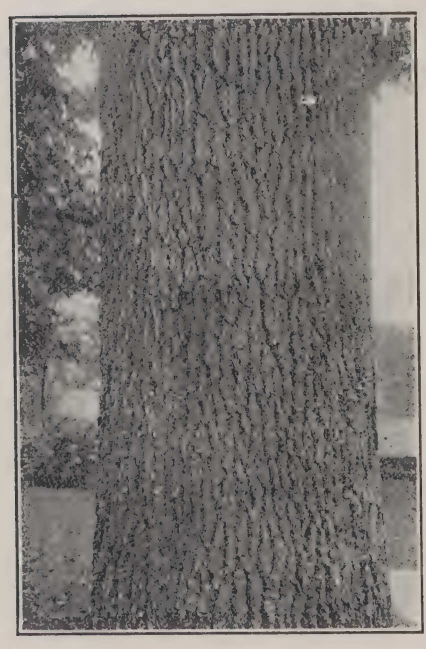

Fig. 93. BLACK OAK
Trunk 42 inches in diameter

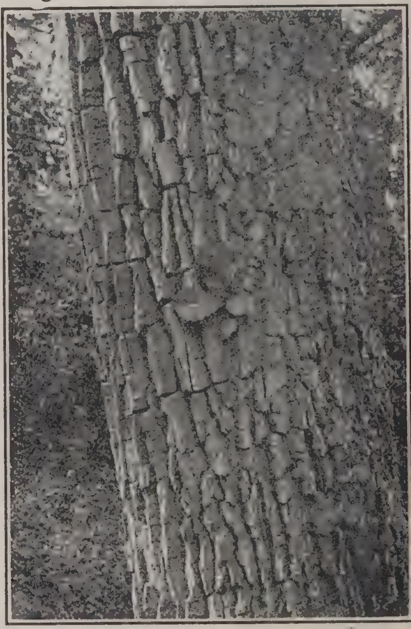

Fig. 94. ROCK OAK
Trunk 34 inches in diameter

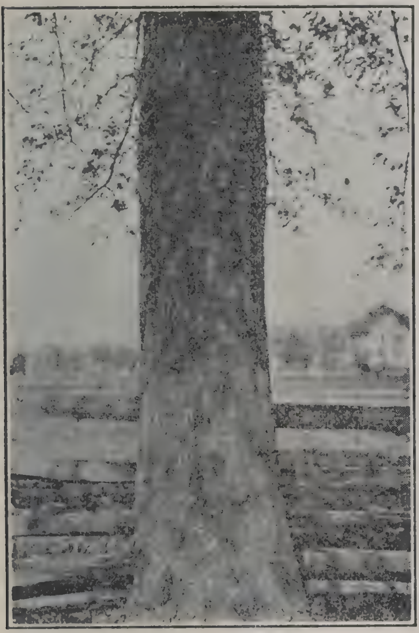

Fig. 95. PIN OAK
Trunk 15 inches in diameter

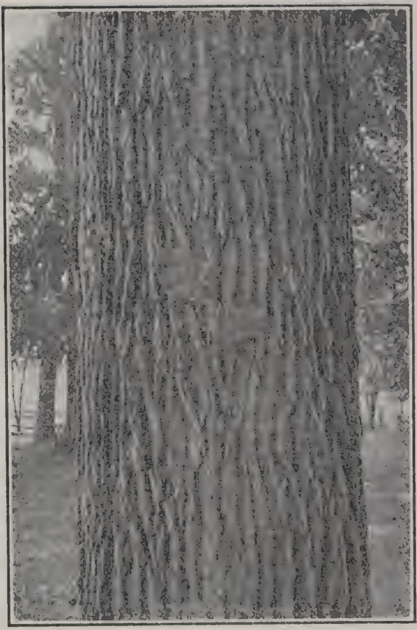

Fig. 96. SWAMP WHITE OAK
Trunk 32 inches in diameter

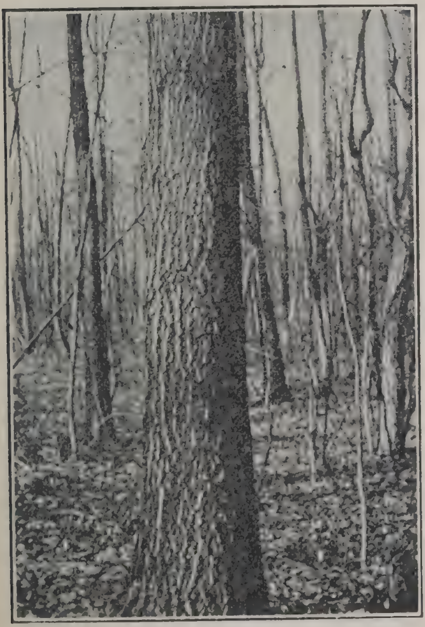

Fig. 97. SCARLET OAK
Trunk 14 inches in diameter

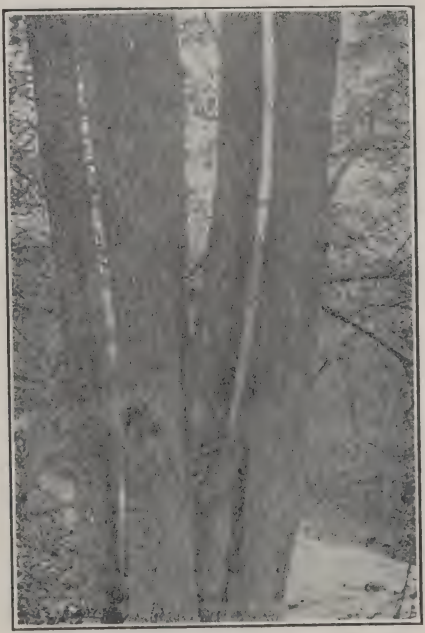

Fig. 98. BASSWOOD
Trunks 8-14 inches in diameter

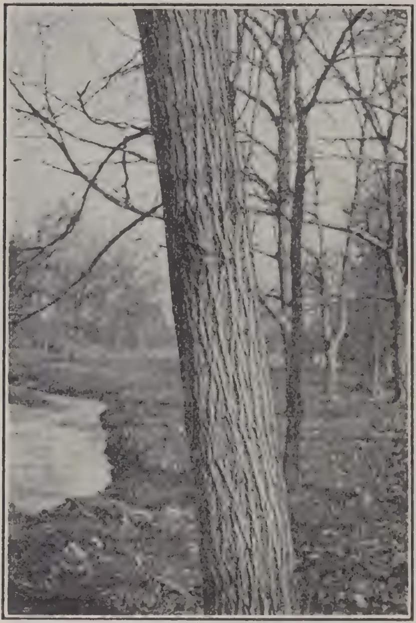

Fig. 99. BUTTERNUT
Trunk 20 inches in diameter

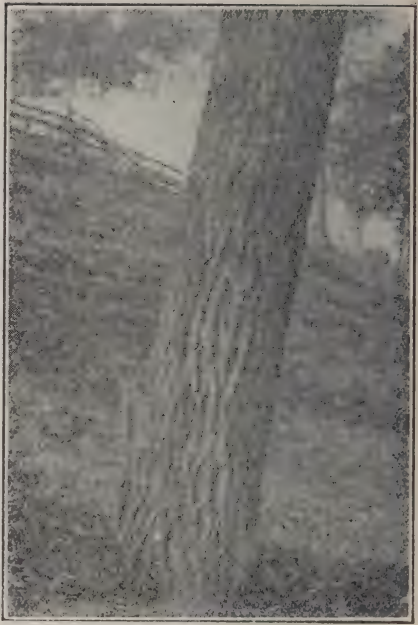

Fig. 100. BLACK WALNUT
Trunk 24 inches in diameter

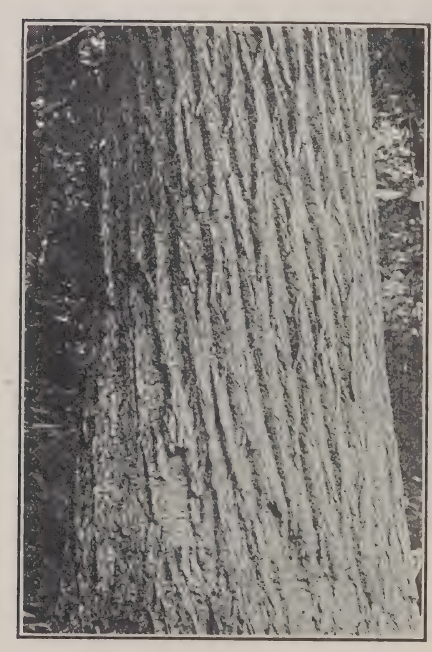

Fig. 101. CHESTNUT
Trunk 62 inches in diameter

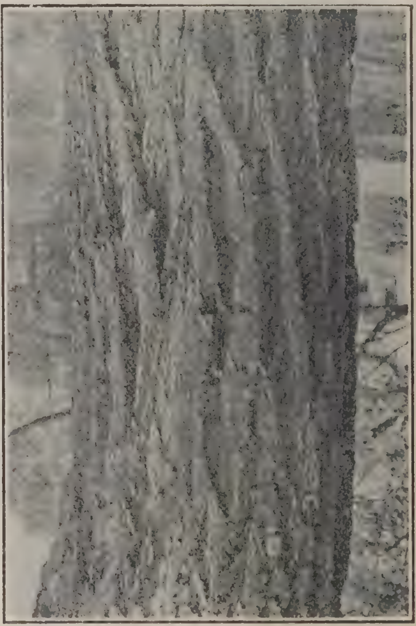

Fig. 102. BLACK LOCUST
Trunk 18 inches in diameter

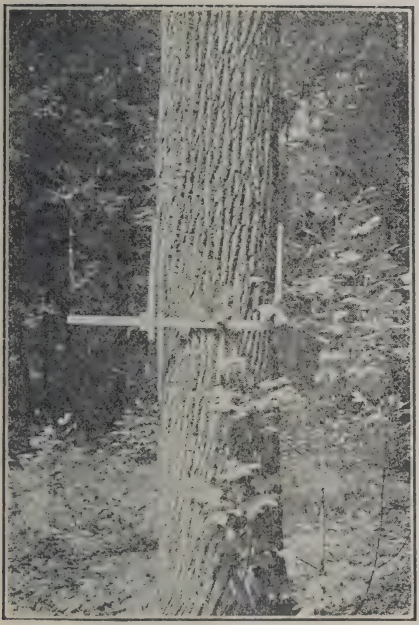

Fig. 103. TULIP TREE
Trunk 21 inches in diameter

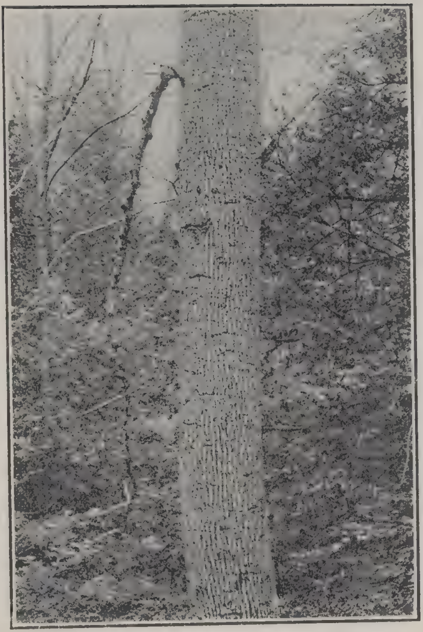

Fig. 104. CUCUMBER
Trunk 26 inches in diameter

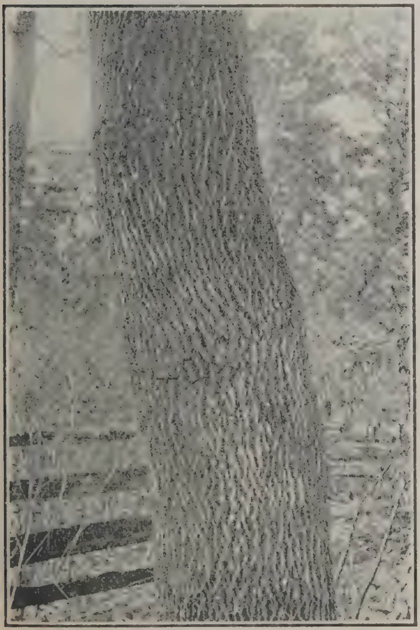

Fig. 105. WHITE ASH
Trunk 30 inches in diameter

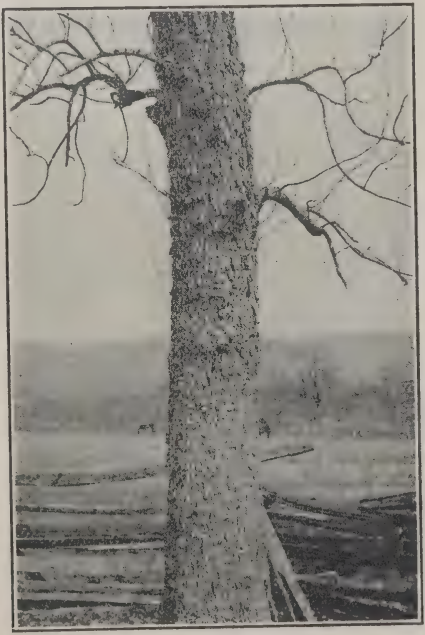

Fig. 106. BLACK ASH
Trunk 22 inches in diameter

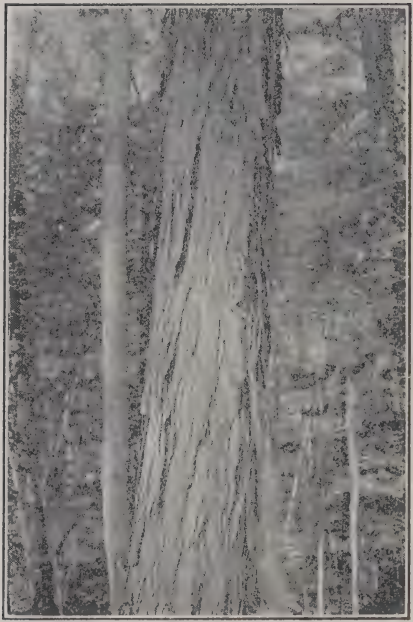

Fig. 107. SHAG BARK HICKORY
Trunk 26 inches in diameter

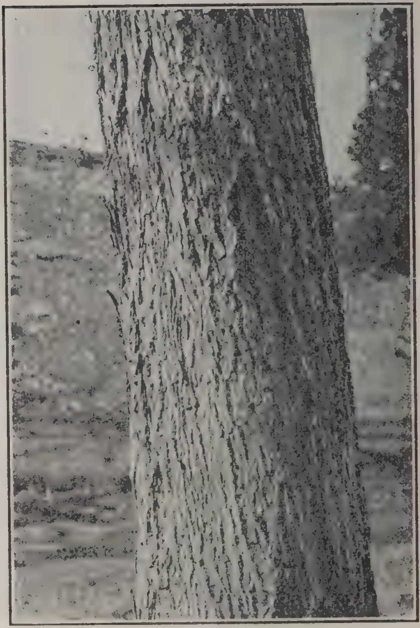

Fig. 108. PIGNUT HICKORY
Trunk 22 inches in diameter

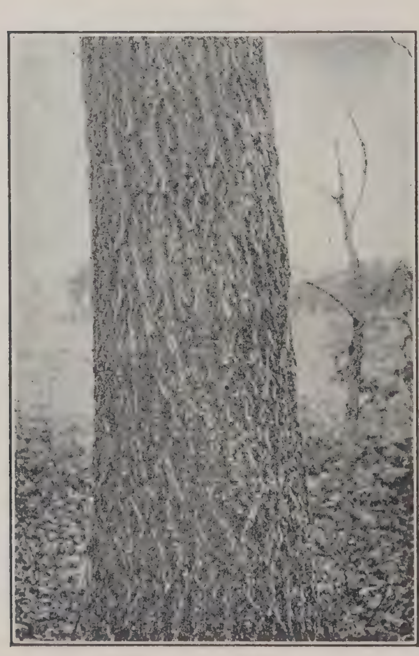

Fig. 109. MOCKER NUT HICKORY
Trunk 18 inches in diameter

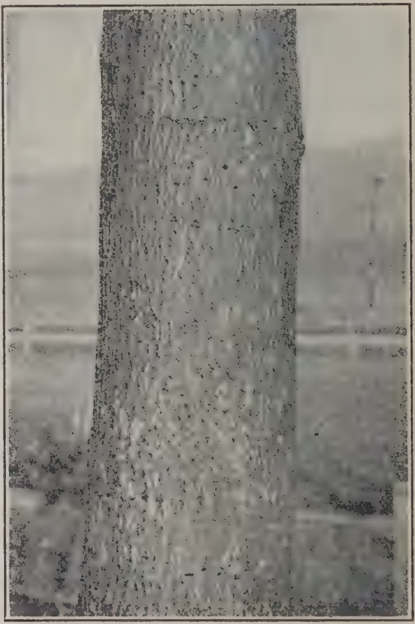

Fig. 110. BITTER NUT HICKORY
Trunk 24 inches in diameter

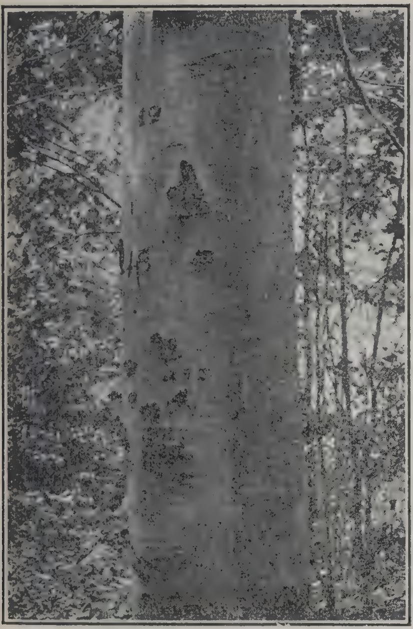

Fig. 111. BEECH
Trunk 30 inches in diameter

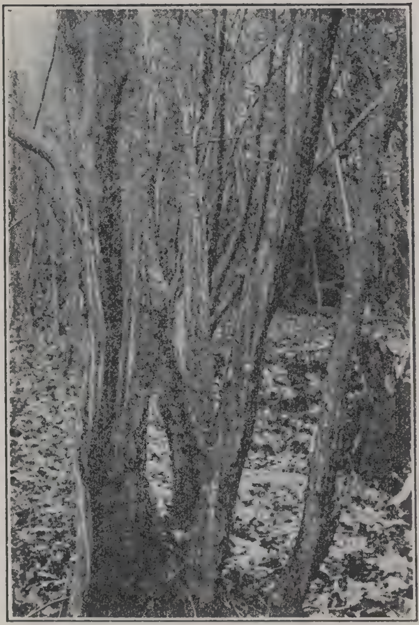

Fig. 112. AMERICAN HORNBEAM
Trunks 6 inches in diameter

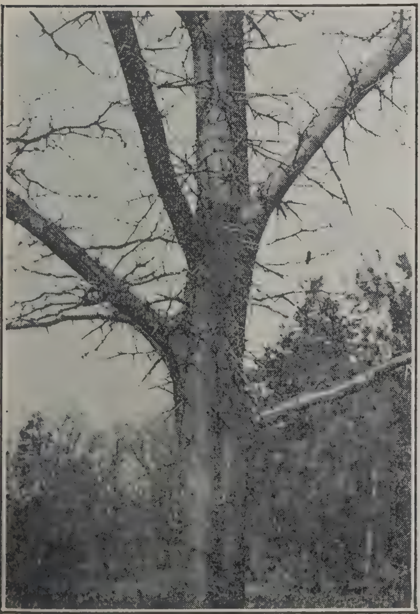

Fig. 113. HONEY LOCUST
Trunk 10 inches in diameter

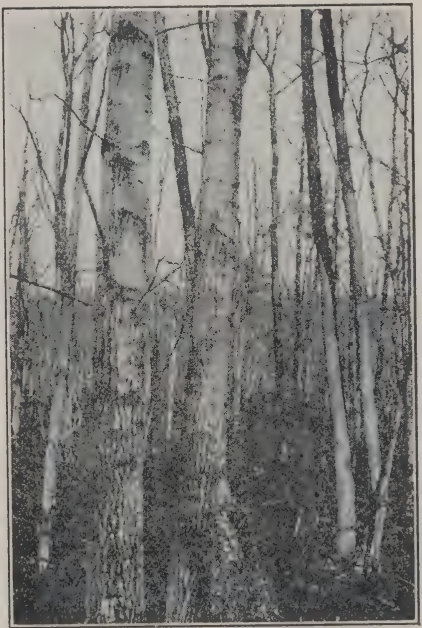

Fig. 114. LARGE-TOOTHED ASPENS
Trunks 16 and 18 inches in diameter

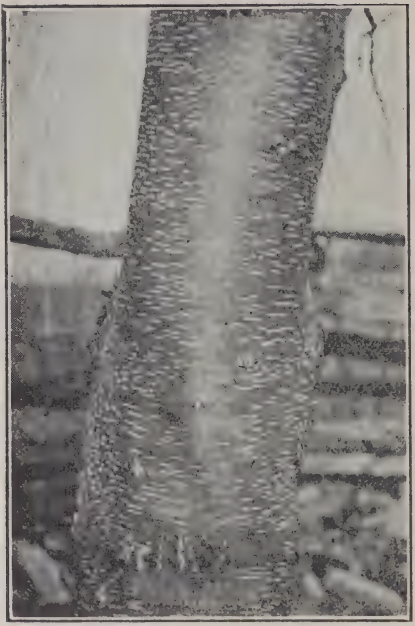

Fig. 115. WILD BLACK CHERRY
Trunk 6 inches in diameter

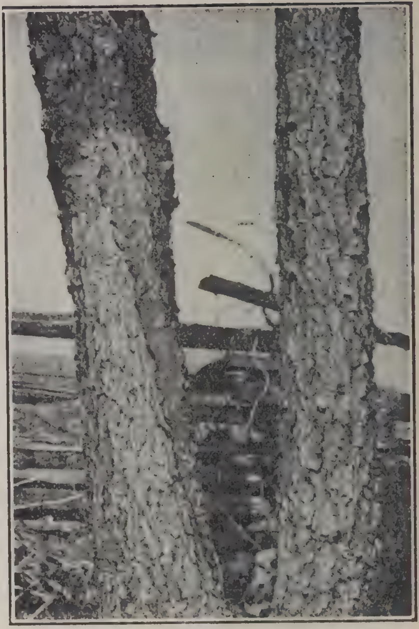

Fig. 116. WILD BLACK CHERRY
Trunk 18 inches in diameter

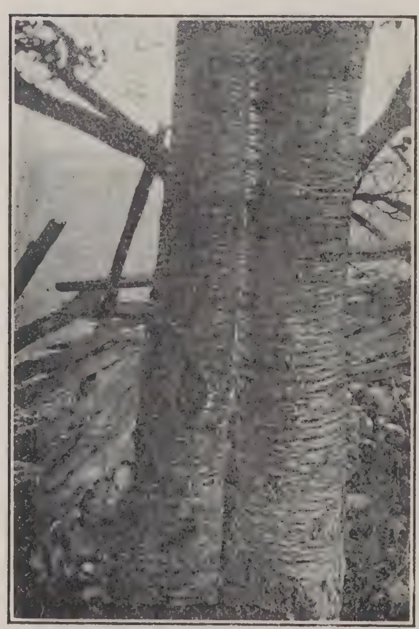

Fig. 117. DOMESTIC CHERRY
Trunks 12 and 14 inches in diameter

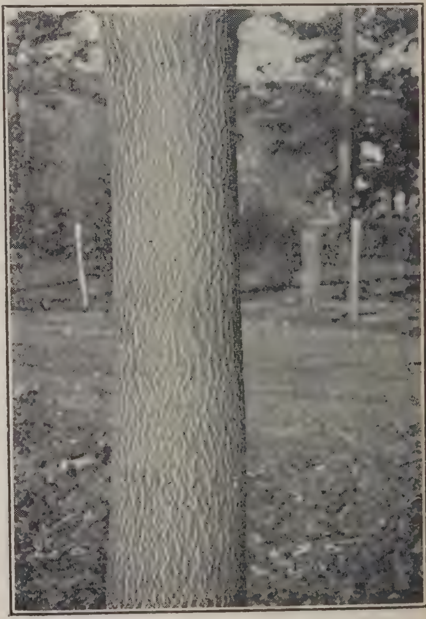

Fig. 118. TREE OF HEAVEN
Trunk 12 inches in diameter

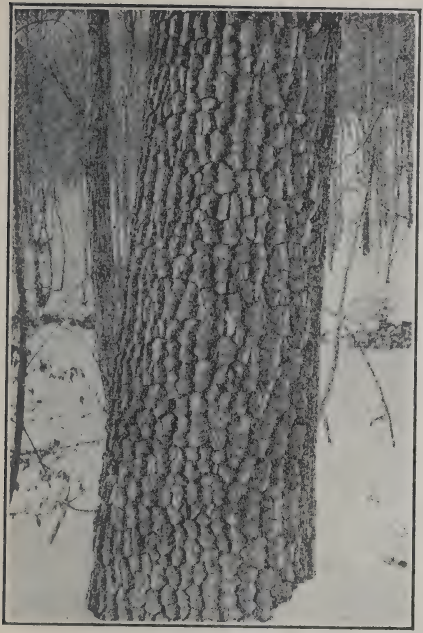

Fig. 119. BLACK GUM
Trunk 22 inches in diameter

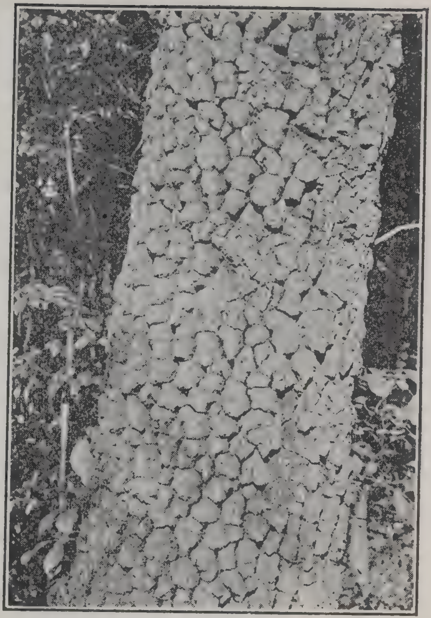

Fig. 120. PERSIMMON
Trunk 12 inches in diameter

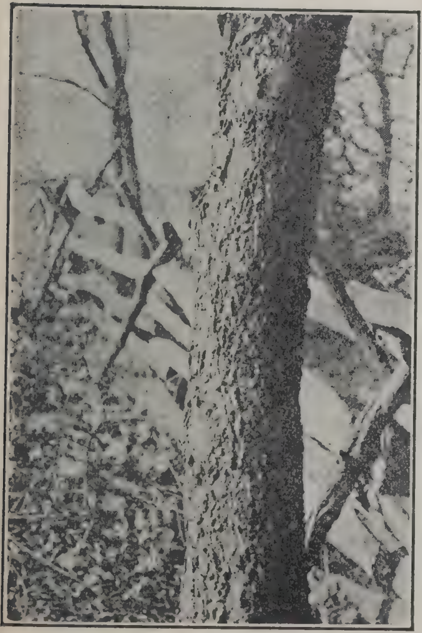

Fig. 121. HACKBERRY
Trunk 8 inches in diameter

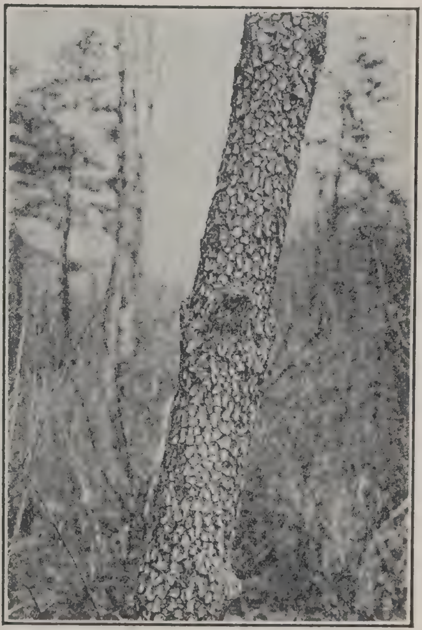

Fig. 122. FLOWERING DOGWOOD
Trunk 6 inches in diameter

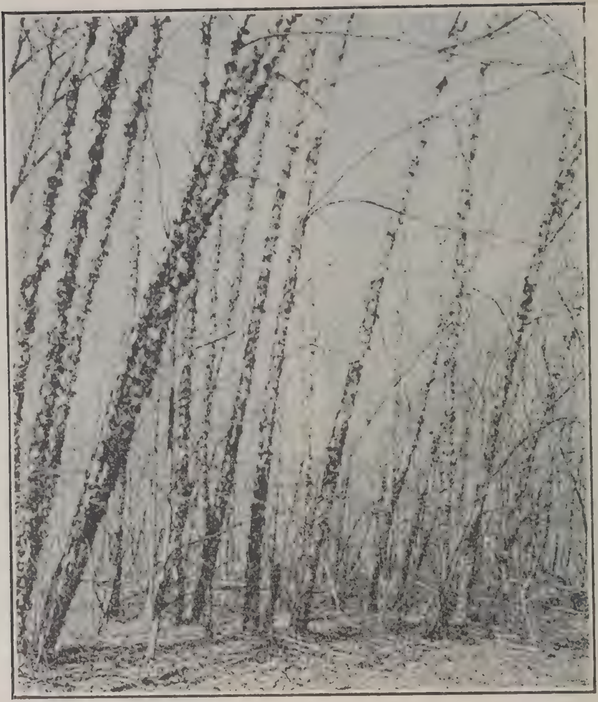

Fig. 123. A STAND OF RED OR RIVER BIRCH
Common along all the principal rivers of the State and their main tributaries

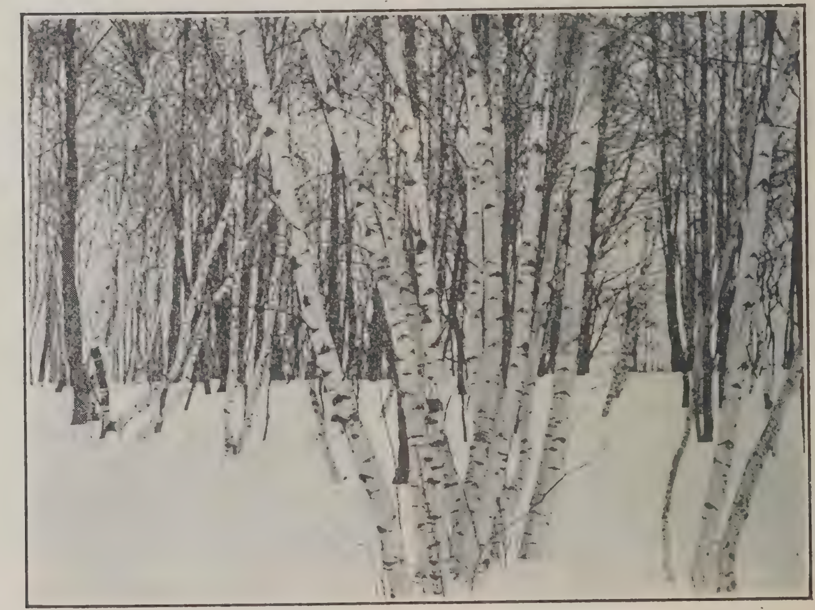

Fig. 124. A STAND OF GRAY BIRCH
One of the most attractive trees of the State

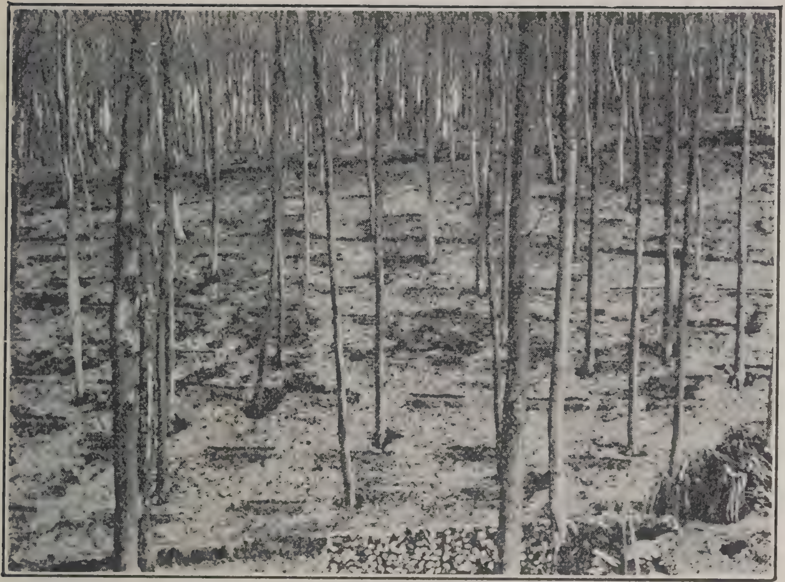

Fig. 125. A MIDDLE-AGED STAND OF EUROPEAN BEECH
It receives proper protection and good treatment. The ground is furrowed to prevent the run-off of the water and to expose mineral soil so as to stimulate regeneration of young trees on the forest floor

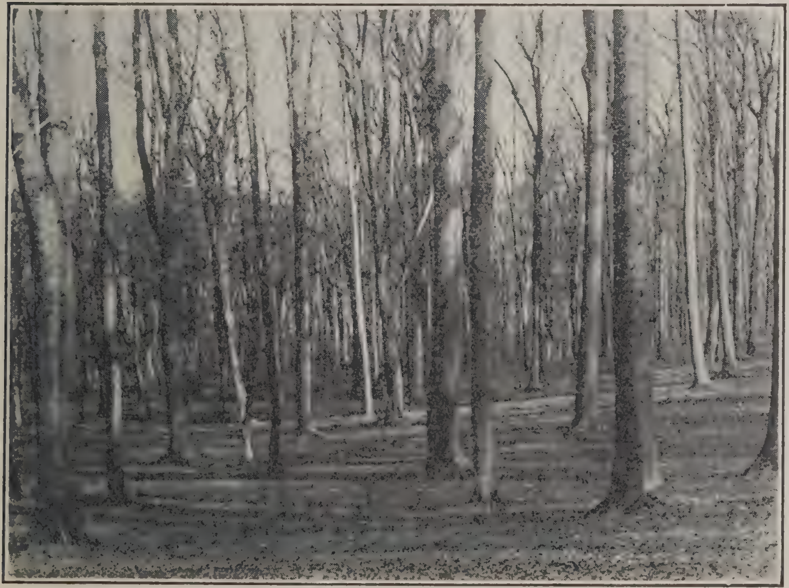

Fig. 126. A WELL CARED FOR STAND OF EUROPEAN BEECH (Fagus sylvatica). THE AMERICAN BEECH WILL RESPOND EQUALLY WELL TO PROPER TREATMENT

varies in different species, in different situations, in different parts of the same species, and with the age of the trees. Young bark is usually green, but it soon loses this color due to the formation of cork and other substances. A few species like Sassafras retain their green color for a relatively long time due to deferred or late cork formation. Gray, brown, and black are the prevailing bark colors while red and white are also common.

Color of the bark is very helpful in distinguishing many of our common trees. All of the Birches native to Pennsylvania may be distinguished from each other by the color of their bark together with a few other bark characteristics. The bark on some of the older trunks becomes rough and then the characteristic color of the trees may be present only on the branches and young stems. The outer bark may be uniform, mottled, or variegated in color. The interior and exterior parts of the bark may differ in color. Black Oak bark is yellow within and black without, while Hemlock is reddish within and brown to black without. The bark of the Buttonwood is peculiar since it is dark brown without and green, yellow, or white within. The inner bark often becomes very conspicuous due to the complete peeling off of the outer bark.

Young branches and stems are usually smooth since the bark expands sufficiently to accommodate the increased diameter growth of the interior. Later, in most species, the bark begins to crack, since the growth of the interior is too rapid for the expansion of the bark. In a few trees like Beech, Blue Beech, and Balsam Fir the bark remains thin and smooth throughout life. Others like Basswood and Pin Oak remain smooth for a long time but become furrowed later, while many others become rough early in life. The manner in which the bark cracks open or peels off affords a ready means of identification for many of our trees. The exfoliation of the bark is rather constant for each species. In some such as the Yellow Birch and Paper Birch it peels off in thin film-like papery layers. In the Shag-Bark Hickory it is shaggy; in the Pines and Spruces it is scaly; while in others like the White Cedar it is shreddy. Many trees have furrowed bark. The furrows usually run in a longitudinal direction but may run transversely. The furrows or fissures separate ridges. These vary with the species. The fissures may be short or long, close or distant, narrow or wide, longitudinal, transverse, or diagonal. The ridges may be pointed or broad, high or low, smooth or scally. The bark may be broken up into small square or rectangular blocks as in the Black Gum. This form of bark is often spoken of as "Alligator bark." See Figures 63-122 for bark of most of our important native trees.

The bark may be of considerable technical value. Hemlock and some of the Oaks and Spruce have bark which is rich in tannin. The bark of these trees is used extensively in the leather industry. The bark of a European Oak is highly prized on account of the large quantity of cork which it produces. The inner bark of some trees yields dyeing material while that of others is used in the manufacture of fibre cloth. Formerly the bark of the Paper Birch was used in the construction of canoes.

3. Twigs:

Twigs are the terminal parts of branches. The term twig usually refers to that portion of the terminal part of the branch which grew in the last season. Those portions of the branch which began their growth a few seasons ago are usually spoken of as older twigs or branchlets. The twigs have their origin in the vegetative buds which may be located on the terminal end of the twig of the previous season's growth or along its side. If they emerge from terminal buds they become leaders, and if from lateral buds they will develop into lateral branches. The lateral branches may be *alternate, opposite,* or *whorled* (Plate II). The method of branching is very helpful in distinguishing our common trees. The lateral branches of most of them alternate with each other, while a fair number are opposite and a few whorled. The terminal twig elongates rapidly while the lateral ones usually remain shorter and occasionally are compressed to a stub or spur.

When the vegetative buds burst open in spring young twigs. which are often covered with developing leaves, emerge from them. These twigs are, at first, usually delicate, greenish in color, and often hairy. As they develop during the season they become firmer and often lose their green color and their hairs. The direction of the new growth is variable. In many trees it takes at first a drooping direction and later, as its elements become firmer, it assumes a horizontal or ascending position. The new growth of the Pines is conspicuous in that it grows in an erect direction at first and later becomes horizontal or drooping.

The taste, smell and color of the twigs are helpful in distinguishing some of our common trees. The twigs of some such as the Black Birch, Spice Bush, Sassafras, and Wild Cherry have a characteristic taste and smell. The color of the twigs may be green as in the Sassafras, red as in the Basswood and Red Maple, or brown as in the Sugar Maple. Many other different colors and combinations of color aid materially in distinguishing our trees.

Some twigs are rough while others are rather smooth. They may be roughened by hairs, lenticels, raised leaf-scars, bud-scale

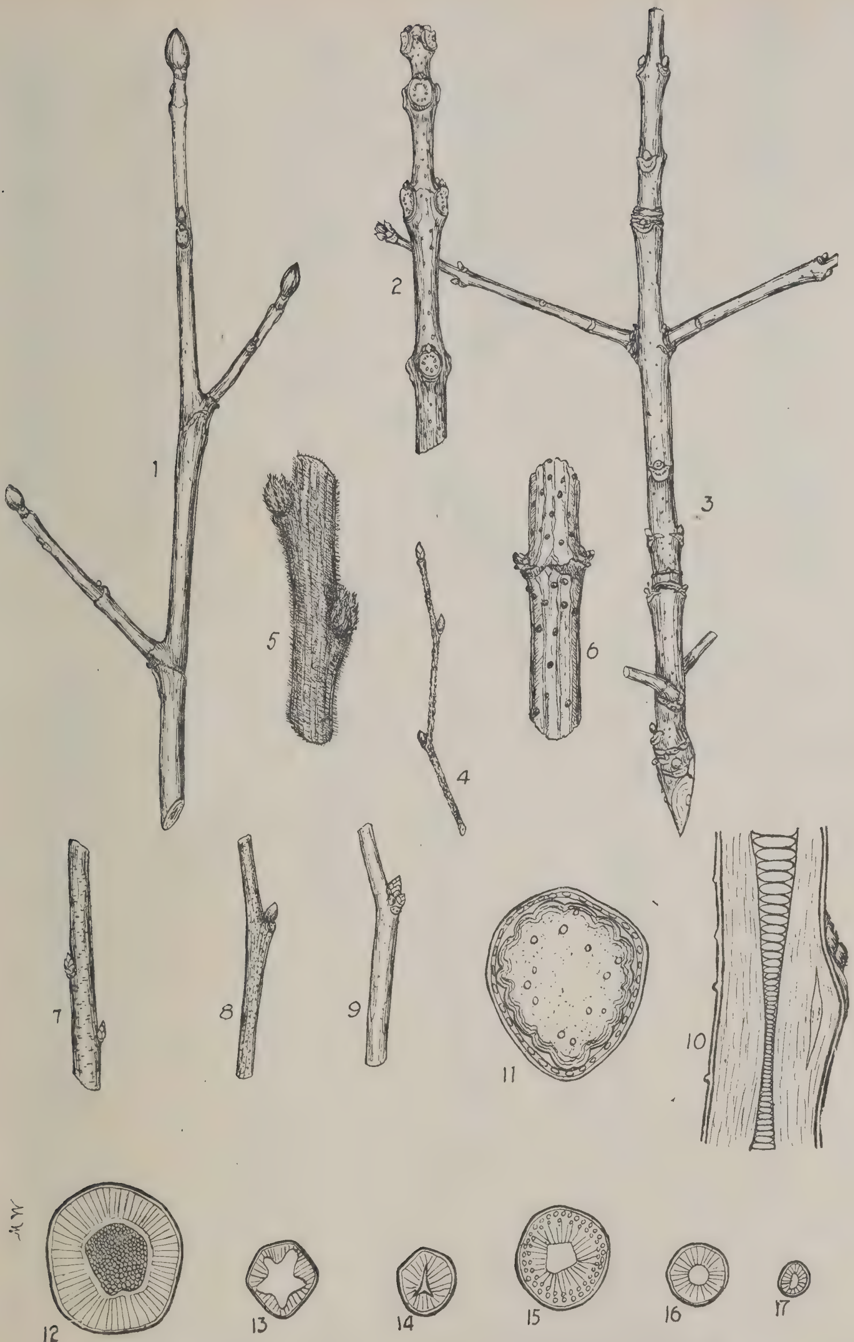

PLATE II. TYPES OF TWIGS AND PITH

1. Tulip Tree (alternate branching).
2. Catalpa (whorled branching).
3. White Ash (opposite branching).
4. Gray Birch (slender and warty).
5. Staghorn Sumach (hairy).
6. Elderberry (lenticels prominent).
7. Black Cherry (lenticels transversely elongated).
8. Chestnut (lenticels small and numerous).
9. Black Gum (lenticels few and inconspicuous).
10. Black Walnut (chambered pith).
11. Sumach (large pith).
12. Sassafras (medium-sized pith).
13. Oak (star-shaped pith).
14. Black Alder (triangular pith).
15. Common Locust (angular pith).
16. Elm (circular pith).
17. Birch (semicircular or irregular pith).

Drawings are about one-half natural size.

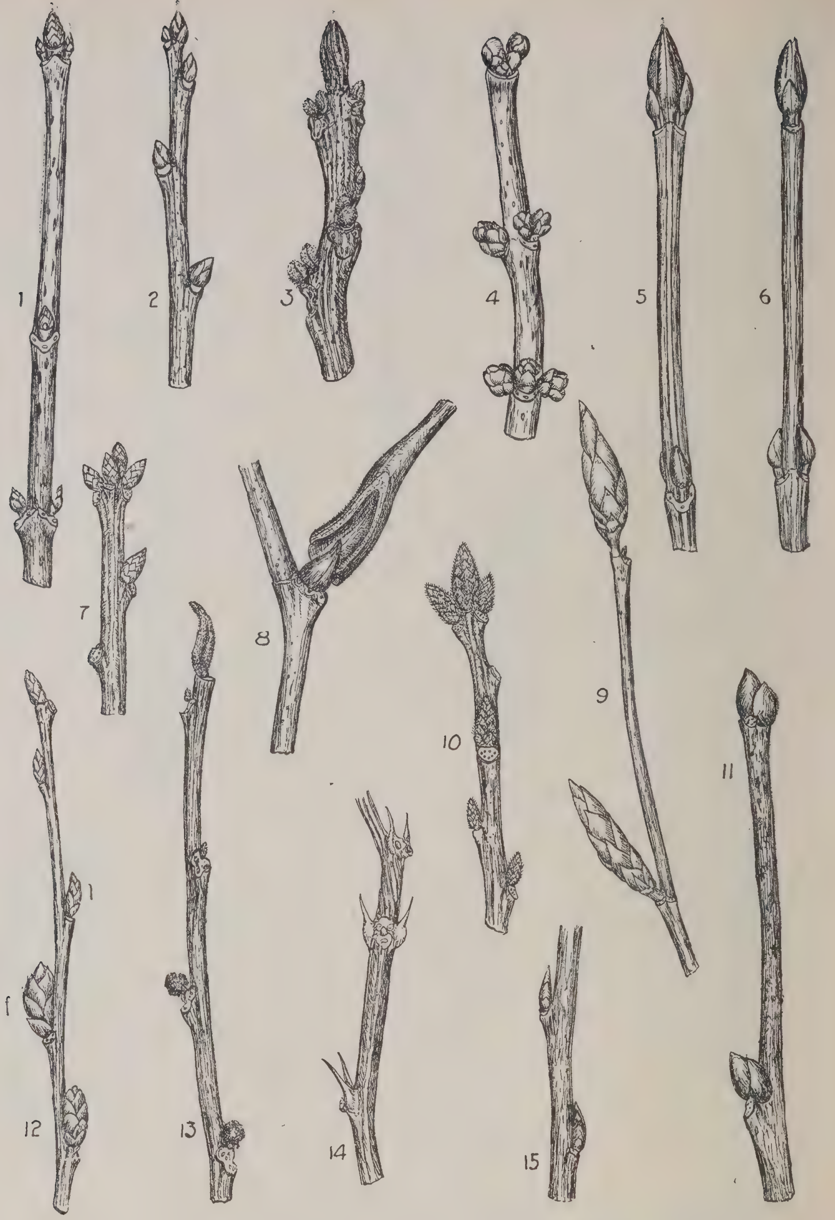

PLATE III. TYPES OF BUDS

1. Sugar Maple (opposite).
2. Chestnut (alternate).
3. Butternut (superposed).
4. Red Maple (accessory).
5. Striped Maple (stalked).
6. Striped Maple (valvate).
7. Red Oak (scaly).
8. Buttonwood (sub-petiolar).
9. Beech (solitary terminal).
10. Black Oak (clustered and hairy terminal).
11. Basswood (axillary and pseudo-terminal).
12. American Elm, showing (l) leaf buds and (f) flower buds.
13. Papaw (naked flower- and leaf-buds).
14. Common Locust (imbedded).
15. Trembling Aspen (sharp-pointed).

Drawings are about one-half natural size.

scars, warty or resinous exudations, corky projections, or decurrent projections of the bark. If we examine a young twig just after it has emerged from the bud we will find that it is usually green in color. At the end of the first season's growth a thick bark has usually developed which is no longer green on the surface, but by cutting a cross section of a twig, one will often find that the inner bark is still green. This green tissue developes chlorophyll and manufactures food just as does the green tissue of the leaves. As the bark increases in thickness the chlorophyll decreases, eventually disappearing entirely from the stem. In order that this green tissue in the bark may function it is necessary that gases be exchanged through the bark. Special structural modifications on the bark known as *lenticels* (Figs. 98 and 100) make possible this exchange of gases just as the stomata on the leaf-surfaces allow and even regulate the exchange of the gases of the leaf.

The lenticels are very numerous and conspicuous on some trees while on others they are rare and inconspicuous. They are raised on some trees like the Elder, while on others they are even with the bark. Their color varies. They may be white, gray, pinkish, yellow, brown, or black. In outline they are usually circular or slightly elongated. In the Cherries and Birches they are confluent, a characteristic which results in the horizontally elongated lines of lenticels (Figs. 115 and 117) so common on their trunks.

The duration of the lenticels varies with the kind of trees and its environment. As a rule the more rapidly bark is formed the shorter is the duration of the lenticels. On some trees it is difficult to find lenticels on any but the last season's growth while on others they may persist for some years. The exfoliation of the bark causes their disappearance. On a few trees like the Birches, Cherries, and Honey Locust they persist for many years.

The distribution of lenticels has not yet been systematized. They are distributed rather uniformly over the newer growth but are irregularly spaced. In some trees they seem to be somewhat clustered just below the nodes and in others like Honey Locust they are more numerous on the lower side of horizontal branches.

The pith usually occupies the central portion of twigs, branchlets, and roots. It is composed of thin-walled cells which are loosely aggregated. It seldom increases in size after the first year. The pith of a tree 100 years old is usually not wider than that in a year old twig of the same species. It becomes functionless early in the life of a tree.

The pith of conifers is rather uniform in outline, structure, and color, but in the broad-leaved trees it is very variable. In most trees it is small in proportion to the size of the twigs, but in a few species like Sumach, Elder, Sassafras, Ailanthus, and Kentucky Coffee-tree it is relatively large. The outline in cross section may be 5-angled or star-shaped as in the Oaks, Chestnut, and Aspens, 3-angled as in Alder and some Birches, angular as in Common Locust, circular as in Elm, and ovoid as in Basswood. As a rule the pith is continuous but in a few trees such as Black Walnut, Butternut, and Hackberry it is chambered. In the latter it is not so distinctly and regularly chambered as in the other two trees. A few trees such as the Catalpa have continuous pith except at the nodes where it is sometimes chambered. A less distinct separation of the pith is found in Black Gum, Papaw, Tulip Tree, and the Magnolias where plates of stone cells occur. The color of the pith may be white as in the Sugar Maple, pinkish as in Red Maple, brown as in Striped Maple, Mountain Maple, Sumachs, and Walnuts, red as in Kentucky Coffee-tree, or greenish as in Shad Bush.

4. BUDS:

In temperate and colder climates the growing season extends over a part of the year only. During the warmer part of the year vegetation is active, but as soon as the weather becomes cooler, many annual plants die while others make special preparation for the winter. One of the preparations is the formation of buds. They are formed in most trees and shrubs of cold and arid climates. If we examine twigs of our common trees in the month of July we can usually find buds starting to develop in the axils of the leaves. In the Buckeyes the winter buds can be found as early as May 10. They continue to develop until they have reached a certain size, and then remain in an inactive condition for a few months in winter, only to become active again when favorable growth conditions return in spring. A year usually includes a period of rest alternating with a period of activity.

Buds may be divided into two classes, *active* and *resting*. Active buds are growing or developing buds, such as one finds in late summer prior to the period of rest and early in spring when the resting buds have been awakened from their winter's slumbers. The resting buds are commonly known as *winter buds* (Plate III).

Buds are protected growing points. The degree of protection given to the growing points varies with the kind of tree. A few of our trees and shrubs have buds which are nearly or quite destitute of a scaly covering. These are known as *naked buds*. The protection usually consistes of scales which may be supplemented by hairy outgrowths, resin, gums, or air spaces. These are known as *scaly buds*. The buds may be covered by numerous overlapping scales, known as imbricated bud-scales, or they may be covered by simply one or two visible scales which do not overlap. The buds of the Willows and Buttonwood are covered by a single visible bud-scale, while the buds of such trees as the Striped Maple and the Black Alder have only two visible bud-scales whose margins simply meet and do not overlap. The latter are known as *valvate buds.* The buds may also receive protection from the enlarged bases of the stalk of leaves which often persist far into winter. The buds covered by the enlarged base of the leaf-stalk are known as *subpetiolar buds.* The buds of some of our common trees are very inconspicuous. It is often difficult to locate them when sunken so deeply into the bark that only the tip is visible. The size of the buds is not indicative of the size of the flowers or leaves which they will produce the following season. Many of the trees which bear small and inconspicuous buds produce large and conspicuous flowers and leaves. The principal functions of the protective covering of buds are the prevention of the loss of water from the tender parts within and the protection of their delicate interior from mechanical injury.) Some tree experts also add that the protection minimizes the damaging effect of sudden temperature changes.

The position of buds is of considerable value in distinguishing many of our trees and shrubs. They may occur at the end of the twigs or along their sides. The former are known as *terminal buds* and the latter as *lateral buds.* The terminal buds may be solitary as on the Beech or clustered as on the Oaks. On most of our trees and shrubs the lateral buds appear just above the origins of leaf-stalks and are known as *axillary buds.* They may occur in pairs, one on one side of the twig and the other exactly opposite, or singly forming a spiral around the twig. The former are known as *opposite buds* and the latter as *alternate buds.* The axillary buds may occur solitary or in groupes, either one above the other, or side by side. If they occur one above the other they are known as *superposed buds* and if they occur side by side they are known as *accessory buds.* Sometimes axillary buds remain inactive for a long period of time without losing their vitality. Such are known as *dormant buds.* During their dormant period they remain on the surface of the trunk by the elongation of their connection with their point of origin. A superabundance of food, excessive light, or the death of a great number of terminally located buds, may stimulate them into activity again. A great number of these buds are often found along the stem of such trees as Chestnut, Pitch Pine and Rock Oak. They develop into short branches which are known as "water sprouts." Some buds are produced at rather unusual points, and in irregular positions along the stem, and are called *adventitious buds.* They also form "water sprouts."

One finds a wide variation in size and form of the buds which our common trees produce. Some are long and slender; others are short and stout. Some of them are round in cross-section; others are angular. Some are sharp-pointed; others are blunt-pointed. The buds also vary in the manner of their insertion on the twigs. Some are inserted directly on the twig; others are separated from the twig by a stalk, and still others may be almost entirely covered by the twig. The former are called *sessile buds,* the next *stalked buds,* and the latter *imbedded buds.*

The kind of buds that a tree produces is of considerable importance, especially where fruit trees are considered. Three principal kinds of buds may be distinguished:—*leaf buds,* also known as *vegetative buds,* the contents of which will develop into stem and leaves; *mixed buds,* the contents of which consist of leaves and flowers in their formative stage; and *flower buds,* also known as *propagative buds,* which contain the elements of flowers only. How can one find out what kind of buds are at hand is a question that troubles many beginners in their study of trees. The following suggestions will be helpful. The buds may be cut open by means of a sharp knife and their contents studied with the aid of a magnifying glass. One may also take a twig and place it in a jar of water in a warm room and in about a week the buds will have expanded far enough to reveal the nature of their contents. The twig with its buds may also be left on the trees and its development observed in spring when nature opens them. With all this variation in the position, insertion, form, structure, and kinds of buds we still find here, as in all nature, law and order.

5. LEAVES:

The shoot of a seed plant consists of stem and leaves. The leaves of our common trees are excellent distinguishing characters by which the species may be recognized. They are variable in form. This variation, as well as the work they do, is little appreciated by the crowds which annually seek their shade and shelter. This chapter aims to give a general description of leaves and a brief outline of their work.

A typical foliage leaf consists of three parts: (1), the *blade* or flattened portion (lamina); (2), the *leaf-stalk* (petiole); and (3), the *leaf-appendages* (stipules).

Two kinds of leaves are usually recognized:—*simple* and *compound* (Plate IV). Simple leaves have blades which are more or less united into one piece, while in compound leaves each leaf is composed of a number of smaller leaflets. Compound leaves may have all the leaflets originate from one point as in the Buckeyes (Plates CXII,

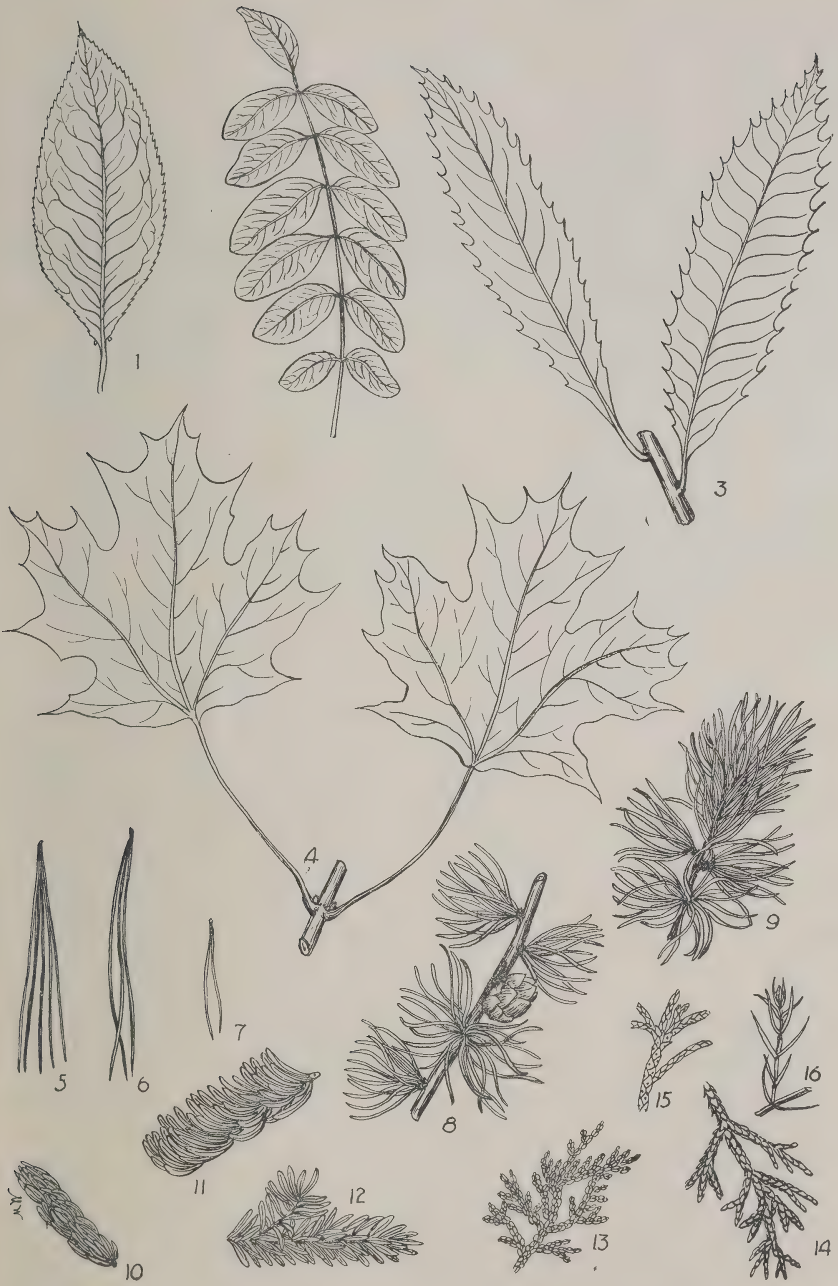

PLATE IV. TYPES OF LEAVES

1. Black Cherry (simple).
2. Common Locust (compound).
3. Chestnut (alternate arrangement).
4. Sugar Maple (opposite arrangement).
5. White Pine (5-clustered).
6. Pitch Pine (3-clustered).
7. Jersey or Scrub Pine (2-clustered).
8. Larch (many clustered).
9. Larch many clustered at base; solitary on leading shoots).
10. Red Spruce (4-sided).
11. Balsam Fir (flat and sessile).
12. Hemlock (flat and stalked).
13. Red Cedar (scale-like needles).
14. Arbor Vitae (scale-like needles).
15. Arbor Vitae (section enlarged showing glands on leaves).
16. Red Cedar (awl-shaped needles).

Drawings are about one-half natural size.

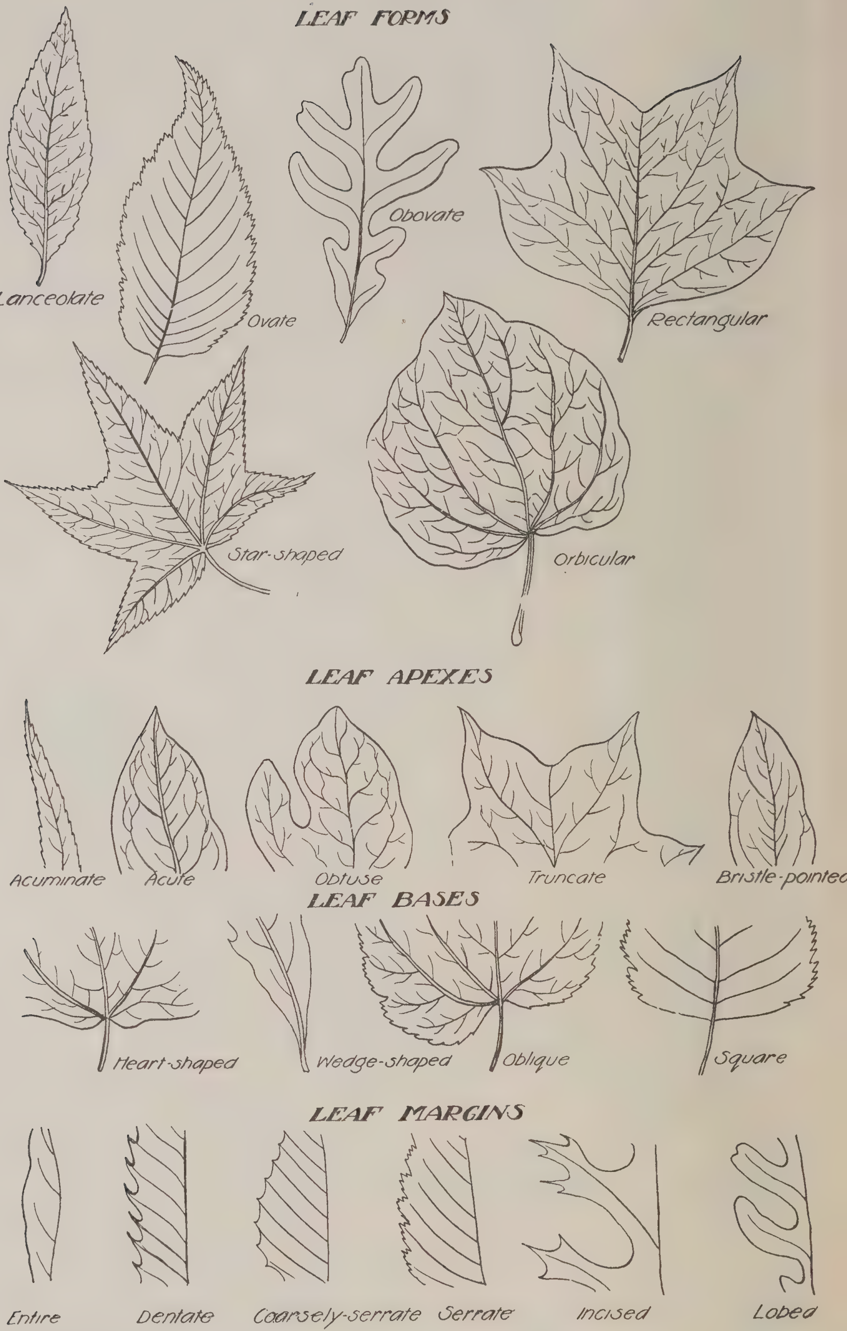
LEAF FORMS
Lanceolate
Ovate
Obovate
Rectangular
Star-shaped
Orbicular
LEAF APEXES
Acuminate
Acute
Obtuse
Truncate
Bristle-pointe
LEAF BASES
Heart-shaped
Wedge-shaped
Oblique
Square
LEAF MARGINS
Entire
Dentate
Coarsely-serrate
Serrate
Incised
Lobed

PLATE V. TYPES OF LEAVES

(CXIII), or scattered along the main petiole as in the Common Locust (Plate XCVII). Each primary division of a compound leaf may again be compounded as in the Kentucky Coffee-tree (Plate XCIV). Such a leaf is known as a *doubly compound leaf.*

The arrangement of the leaves on the twigs and branches of our common trees may be *alternate, opposite,* or *whorled* (Plate IV). When the arrangement is alternate, the individual leaves are located singly at a node; when opposite, two leaves occur opposite each other at a node; and when whorled, more than two leaves occur at a node and are distributed regularly around the twig. In a few trees as the Birches, the leaves of the lateral spurs appear to be opposite, but upon closer examination they are found to be alternate.

The leaves of the trees native to this State may be classified as follows: (1) Trees with needle-shaped leaves, known as conifers or evergreens, and (2) trees with broad leaves known as hardwoods or deciduous trees. The needle-shaped trees show a wide variation in the form and distribution of their needles. They may occur singly, in bundles of 2, 3, or 5, or in clusters on lateral spurs; they may also be stalked or sessile, scale-like or awl-shaped, and flat, semicircular, triangular, or four-sided in cross-section. The broad-leaved trees have an even wider variation in form. This may be in part due to the greater number of representatives belonging to this order. A few of the commonest leaf forms are shown on Plate V. Other intermediate forms are commonly found among our trees. The size of the leaves varies as much as their form. They may be small, scale-like, or awl-shaped as in the Arbor Vitae and Common Juniper, respectively, or large and tropical-like as in the Magnolias and Papaw.

The point, or apex, of leaves varies with the kind of tree and the general leaf-form. The commonest kinds of points recognized are shown on Plate V.

The bases of leaves are also often characteristic and of considerable value in distinguishing trees since different species may have the same general form but different bases. The commonest kinds of bases recognized are shown on Plate V. Intermediate forms may readily be found, since leaves taken from the same tree or branch often show a wide variation.

The margins of leaves are often more variable than their apexes and bases. The kinds most commonly recognized are shown on Plate V. The figures represent the margins of simple leaves. The margins of the leaflets of compound leaves follow the same terminology.

Most of the leaves of our common forest trees contain a rather complicated system of fibro-vascular bundles. These fibro-vascular bundles, known as veins, form the framework of the leaves. Surrounding and between these veins is found a green pulpy mass, the spongy parenchyma. The whole body of the leaf is covered by a protective covering known as the epidermis, the thickness of which varies with the species of tree and the climate.

One can find variations in the petiole and stipules of leaves as well as in the blade. The petiole may be absent, short, or long. When the petiole is absent the leaf-blade is *sessile*. It may also be enlarged at the base, circular, heart-shaped, flat, or triangular in outline. The enlarged base may be hollow or clasping. The stipules are usually not very conspicuous. In many trees they persist for a short time only and then fall off. The main function of the stipules is protection, but a special modification of the stipules is seen in the Common Locust (Plate XCVII), where the thorns are modified stipules and function as mechanical protectors.

Leaves are the most industrious organs of a plant. They work day and night from early spring until autumn. The four chief functions of leaves are: (1) Photosynthesis; (2) Respiration; (3) Transpiration, and (4) Assimilation. Photosynthesis is the process by which the leaf manufactures starch or sugar from carbon dioxide and water with the aid of the energy of light. That green plants require light for their growth and development is shown by the manner in which the axis and their leaves adjust themselves so as to receive the greatest amount of light.

By respiration in plants is meant the process by which oxygen is consumed and carbon dioxide and water are given off. It is primarily a process of oxidation and resembles in general the process of respiration as found in man and higher animals. In order to facilitate this exchange of gases the plants are supplied with openings on the leaf surfaces, especially on the lower surface, and on the bark. The openings on the leaf surfaces are known as stomata and those on the bark as lenticels. Each slit-like opening on the leaf is surrounded by two guard cells which are somewhat complicated in structure and very sensitive to changes in temperature and water supply. They function primarily as breathing pores and as outlets for the water vapor given off during the process of transpiration. Their number varies, but it has been estimated that the lower leaf surface of Black Walnut contains about 300,000 per square inch.

The leaf is not only peculiarly modified for the reception of light and the absorption of gases, but also for the loss of water. This process of losing water in the form of vapor through the stomata is known as transpiration. The large amount of water given off by trees is usually not appreciated. The Austrian Forest Experiment Station has published data which show that an open-grown birch tree

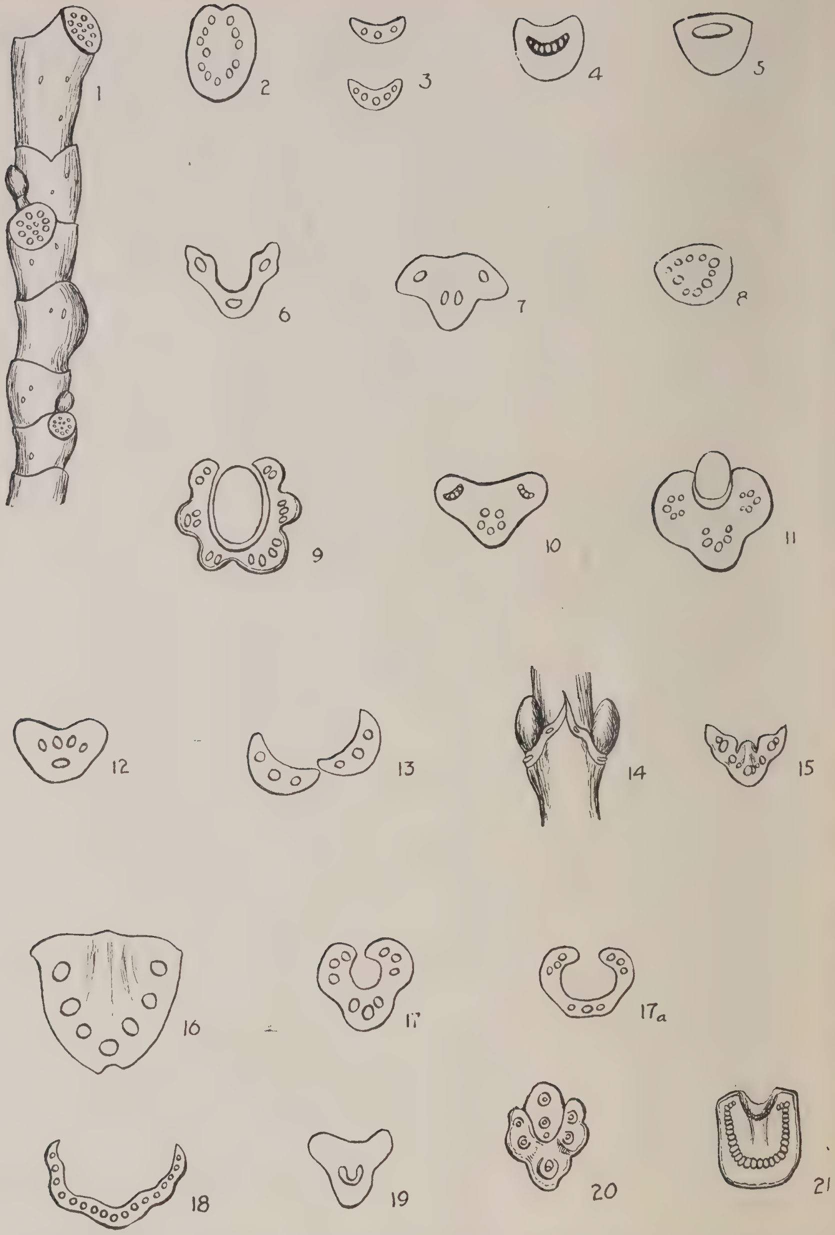
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PLATE VI. TYPES OF LEAF-SCARS AND BUNDLE-SCARS

1. Tulip Tree.
2. Catalpa.
3. American Hornbeam.
4. Sassafras.
5. Persimmon.
6. Maple.
7. Poplar.
8. Red Mulberry.
9. Buttonwood.
10. Chestnut.
11. Walnut.

All drawings are slightly enlarged.

12. Basswood.
13. Birch.
14. Box Elder.
15. Papaw.
16. Horse Chestnut.
17. Dwarf Sumach.
17a. Staghorn Sumach.
18. Hercules' Club.
19. Sour-wood.
20. Kentucky Coffee Tree.
21. Ash.

with 200,000 leaves transpired on hot summer days from 700 to 900 pounds.

Assimilation, the fourth of the functions named above, comprises a series of changes which are necessary to transform the raw or newly manufactured food material into actual plant tissue.

6. LEAF-SCARS AND BUNDLE-SCARS:

Most of our trees and shrubs, except the cone-bearers, shed practically all their leaves in autumn. Those which shed their leaves in this manner are known as *deciduous* trees, while those which retain them for two or more seasons are known as *evergreen* trees. When a leaf falls a scar is left at the point of its attachment. The leaf-scars vary in size, form, position, occurrence, and the number of vascular bundles which they contain (Plate VI). They may occur singly, in pairs, or in whorls, just as the leaves which precede them. They appear at points on the twigs known as *nodes.* The portion of the twig between the nodes is called the *internode.* They may be large, medium, or small in size depending upon the kind of tree. If they occur in pairs on opposite sides of the twig they may be so large that they completely encircle the stem, or only a portion of it. Their form may be round, oval, elliptical, heart-shaped, shield-shaped, crescent-shaped, lobed, or triangular. They may be raised, depressed, or even with the surface of the twig. Their surface may be flat, concave, smooth, or wavy.

The leaf-scar contains bundle-scars. The bundle-scars mark the position of the vascular bundles which formed a connection between the leaves and the twigs. They carry liquid material to and from the leaves. Two distinct portions may be distinguished in these vascular bundles; the woody portion which serves to carry water into the leaf, and the sieve-tube portion which serves to carry plant food from the leaves where it was manufactured, down into the twigs, branches, and stem. These bundle-scars vary in size, form, and number in a leaf-scar, and the manner in which they are distributed. Some of our common forest trees have only one bundle-scar in a leaf-scar, while many have three, and others four, five, to many. The number is constant in some species and variable in others. The individual bundle-scars usually are circular in outline but may be linear, crescent-shaped, or irregular.

Where more than one bundle-scar is found in a leaf-scar they vary in their arrangement. They may form a closed ellipse, a lunate line, a double line, a V-shaped or a U-shaped line, or they may be irregularly scattered over the leaf-scar, or grouped in clusters. A number of bundle-scars may sometimes be grouped so close together so as to form a compound bundle-scar or a line of confluent bundle-scars.

The leaf-scars together with their bundle-scars are excellent characters with which to distinguish many of our common forest trees during winter when most of the distinguishing characteristics which one can use in summer are absent. By carefully studying these characteristics, together with others, it is as easy to distinguish the forest trees in winter as in summer when the foliage is present.

7. FLOWERS:

Sometime in their life history plants usually give rise to others of their kind. The method which they use to accomplish this varies with the species or the tree group. Most of our trees develop flowers whose chief function is pollination, the initial step in the production of seeds. The existence of flowers is consequently for the good of the plant and not for the good of man, even though their beautiful forms and colors do please his fancy and make his life happier.

The flowers of our common trees vary considerably in form, structure, and color (Plate VII, VIII). Most of them are very modest in appearance while a few of them are conspicuous on account of their large size and brilliant color. In speaking of the flowers of our trees collectively, one often hears the phrase "The uncommon flowers of our common trees." The truth of this phrase becomes clear when we think of the small and inconspicuous pistillate flowers produced by such trees as the Oaks, Birches, American Hop Hornbeam, Walnuts, and Hickories. A few trees as the Magnolias, Cherries, Dogwoods, Tulip Tree, and Basswood produce rather conspicuous flowers.

The parts of a flower are of two general kinds—the *essential organs* which are concerned in the production of seeds and the *floral envelopes* which act as protecting organs. The essential organs consist of two series,—the outer which is composed of *stamens* and bears the pollen, and the inner which is composed of *pistils* and bears the seeds. The floral envelopes also usually consist of two series,—the outer which is composed of sepals, collectively known as the calyx, and the inner which is composed of petals, collectively known as the corolla. The corolla is usually the showy part of a flower while the calyx is usually green in color. A flower which has calyx, corolla, stamens, and pistils is said to be *complete*. If any part is wanting it is *incomplete*. When both the floral envelopes are wanting it is *naked*. A flower in which the pistils are lacking is known as a *staminate flower*, while one in which the stamens are lacking is known as a *pistillate flower*. Sometimes the staminate and pistillate flowers are not only found on different parts of the same tree but on entirely different trees.

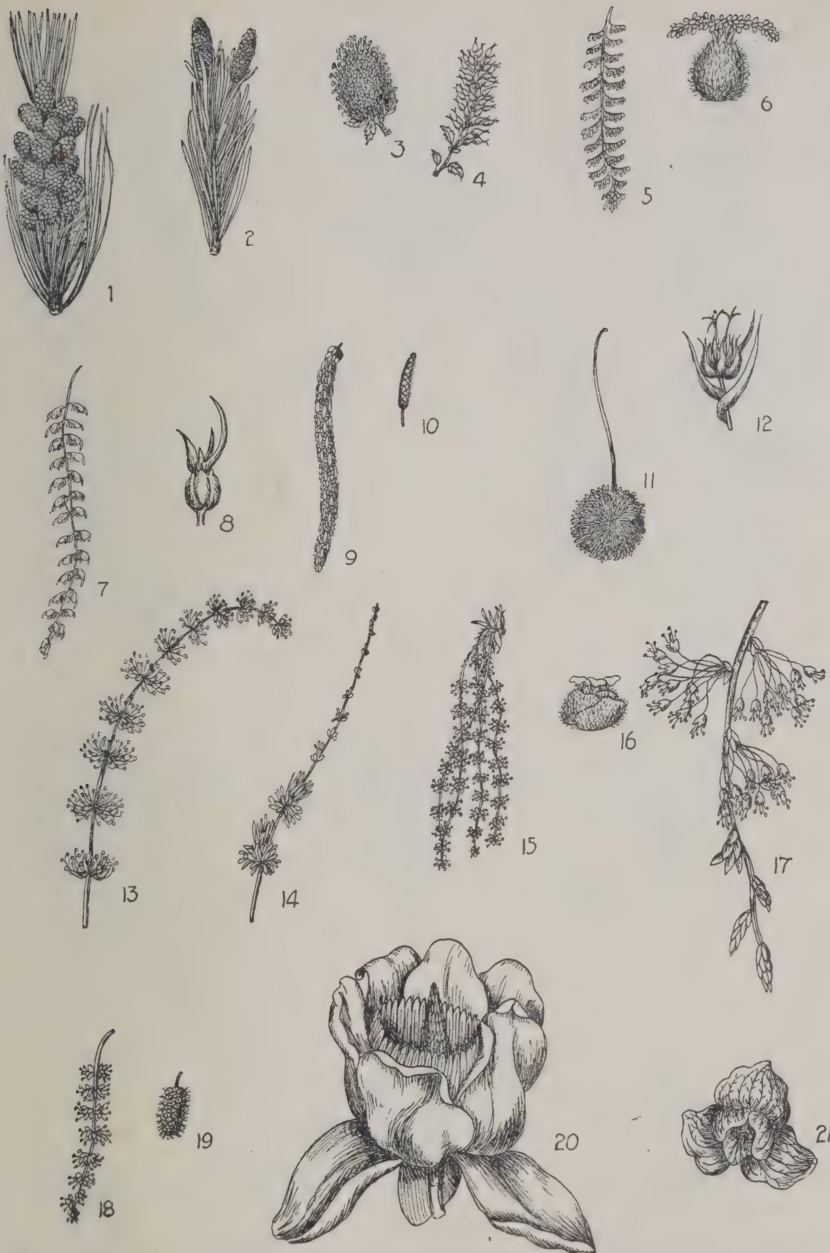

PLATE VII. FLOWERS AND FLOWER ARRANGEMENT

1. White Pine (staminate cluster), x ½.
2. White Pine (2 pistillate), x ½.
3. Willow (staminate ament), x ½.
4. Willow (pistillate ament), x ½.
5. Walnut (staminate ament), x ½.
6. Walnut (a pistillate flower), enlarged.
7. Hickory (staminate ament), x ½.
8. Hickory (a pistillate flower), natural size.
9. Birch (a staminate ament), x ½.
10. Birch (a pistillate ament), x ½.
11. Beech (a staminate head), x ½.
12. Beech (two pistillate flowers), natural size.
13. Chestnut (a staminate ament), x ½.
14. Chestnut (a pistillate ament), x ½.
15. White Oak (4 staminate aments), x ½.
16. White Oak (a pistillate flower), enlarged.
17. Elm (3 clusters of incomplete flowers), x ½.
18. Mulberry (a staminate spike), x ½.
19. Mulberry (a dense pistillate spike), x ½.
20. Tulip Tree (a complete flower), x ½.
21. Papaw (a complete flower), x ½.

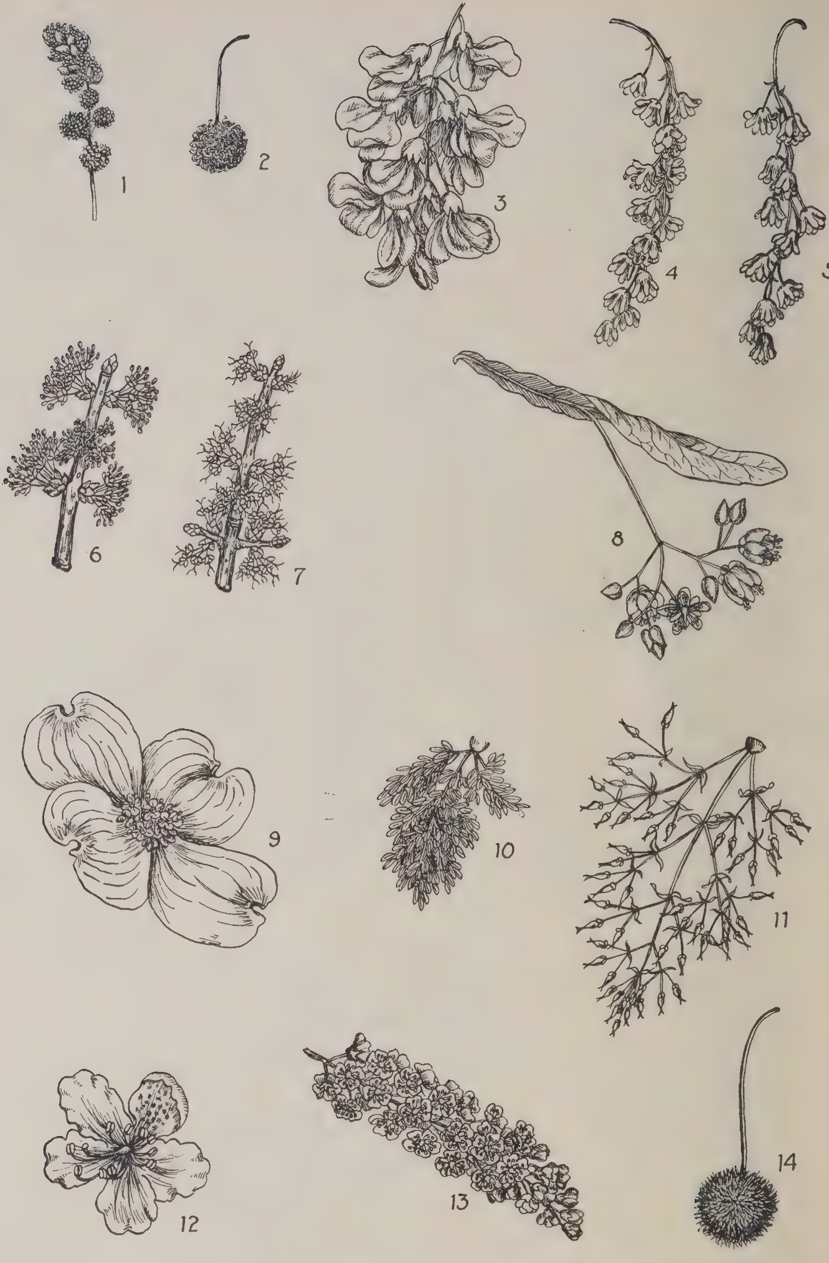

PLATE VIII. TYPES OF FLOWERS

1. Sweet Gum (staminate heads), x ½.
2. Sweet Gum (a pistillate head), x ½.
3. Common Locust (a drooping receme), x ½.
4. Striped Maple (a drooping staminate raceme), x ½.
5. Striped Maple (a drooping pistillate raceme), x ½.
6. Red Maple (staminate fascicles), x ½.
7. Red Maple (pistillate fascicles), x ½.
8. Basswood (a drooping cyme), x ½.
9. Flowering Dogwood (a dense cluster), x ½.
10. White Ash (a staminate panicle), x ½.
11. White Ash (a pistillate panicle), x ½.
12. Rhododendron (a single flower), x ½.
13. Wild Black Cherry (a raceme), x ½.
14. Buttonwood (a head), x ½.

The chief role of flowers is pollination. Pollination is the transfer of pollen from the anther of the stamen to the sigma of the pistil. When pollen is transferred from the anthers to the stigma of the same flower it is known as *close-pollination,* and when pollen is transferred from the anthers of a flower of one plant to the pistil of a flower of another it is known as *cross-pollination.* Wind and insects are the chief agents which carry the pollen in the case of cross-pollination. The flowers of the Tulip Tree, Papaw, and Cherries, are examples in which close-pollination can take place, while the flowers of the Willows and Poplars are good examples in which cross-pollination takes place. When the staminate and pistillate flowers are on the same plants, e. g. Oaks, American Hop Hornbeam, Beech, Chestnut, Hickories, and Walnuts, the plants are known as *monoecious* and when they are on different plants as in the Willows, Poplars, and occasionally some Maples, they are known as *dioecious.*

Flowers vary not only in the size, form, shape of their parts, and color, but also in their arrangement. In a few cases the flowers of trees like the Tulip tree and Papaw are borne singly and known as *solitary flowers.* The flowers may also be arranged in clusters like that of the Lily of the Valley or the Wild Black Cherry (Plate VIII, 13). Such an infloresence is known as a *raceme.* A raceme may be compact as in the Wild Black Cherry; or loose as in the Common Locust (Plate VIII, 3) and the Striped Maple (Plate VIII, 4-5). When the flower cluster is dense and the flowers sessile, or nearly so, it is known as a spike. Spikes may be 2-5-flowered as in the pistillate flowers of the Hickory (Plate VII, 8), or densely flowered as in the staminate flowers of the Mulberry (Plate VII, 18). A very short and dense spike is known as a *head* (Plate VIII, 14). A spike is sometimes short, flexible, and rather scaly as in the Willows, Poplars, and rather long as in the staminate flowers of the Oaks, Hickories, Birches, and Alders (Plate VII, 7, 9 and 15). Such a spike is known as an *ament* or *catkin.* Other types of inflorescence are the *umbles* (Plate LXXXVII), *panicles* (Plate VIII, 10-11), and *corymbs.*

The time at which the flowers appear and their duration varies with the kind of tree. The Alders, Hazlenut, and some Maples produce their flowers early in spring before the leaves are out. Others produce them with the leaves, while still others produce them after the leaves. The Witch-hazel produces its flowers late in fall. It is the last of our trees to blossom.

8. Fruit:

Sometime after pollination the egg cell or ovule is fertilized, and as a result of fertilization, the ovule, together with the surrounding ovary, enlarges. The enlarged ovules, together with inclosing ovary, form what is termed the fruit. The fruit may in addition comprise modifications of other organs intimately connected with the ovary.

Seeds are productive of the flower and are usually regarded as reproductive organs, but in reality they are the result of reproduction. Their chief work is the dissemination and the protection of the offspring of reproduction. They are usually covered by hard and impermeable coats which protect the young plant contained within from the many dangers with which it is beset. Nature tries to guard against these dangers by developing suitable protective coverings for each species. Nature, however, is not always satisfied by simply developing a thick and impermeable coat, but in addition it develops an internal tissue which is compact and contains little water. If a seed possess these essentials it is well protected against most of the destructive agencies to which it is exposed. The chief dangers to which seeds are subject are premature germination, loss of vitality, and destruction by animals. Each seed usually has a suitable covering which regulates the germination in spring. This regulation is necessary so as not to allow the tender plant to emerge before the external growth conditions are favorable for its development. An embryo within a thin-coated seed would often be stimulated by a few warm days in spring with the consequence that the resulting tender plants would be killed by later frost. Nature acts as a guardian and places a thick coat around such embryos, and as a result they are not stimulated until later when frost danger is past.

Food is stored in various plant organs such as roots, stem, and branches, and is usually most abundant and conspicuous in the seeds. It occurs in various forms and may often differ in composition. Food stored in the seed is very valuable because it supplies nourishment to the small and tender plants before they have developed the roots with which they draw nourishment from the soil and supply water to the leaves where starch and sugar are manufactured. Primitive man obtained considerable food from the seeds of trees, and present man derives certain foods for himself and his animals from some of our common trees. The food value of seeds varies with the species. Some species like the Willows contain very little food, while others like the Chestnut are rich in food.

The time at which the fruit matures varies with the kind of tree. Willows, Poplars, and Elms mature their fruits in spring; others, like the Cherries, Mulberries, and some Maples, in summer; but most of them, like the Oaks, Chestnut, Pines, and others in autumn. The seeds of some trees like the Willows die unless they germinate soon after they mature. Most seeds retain their capacity to

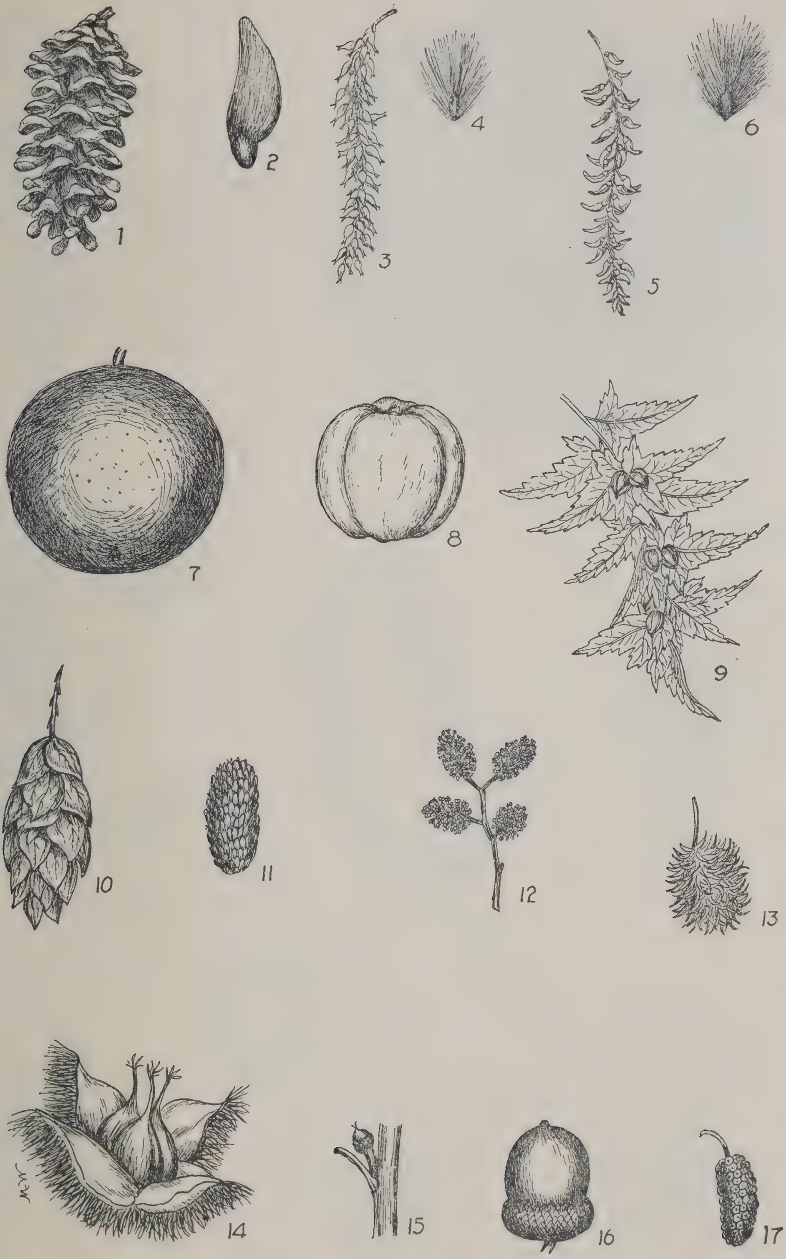

PLATE IX. TYPES OF FRUIT

1. White Pine (cone), x ½.
2. White Pine (winged seed), natural size.
3. Willow (capsules), x ½.
4. Willow (a winged seed), enlarged.
5. Trembling Aspen (capsules), x ½.
6. Trembling Aspen (a winged seed), enlarged.
7. Black Walnut (a nut with indehiscent husk), x ½.
8. Hickory (a nut with dehiscent husk), x ½.
9. American Hornbeam (a nut with 3-lobed bract), x ½.
10. American Hop Hornbeam (a nut inclosed in bladder-like bract), x ½.
11. Black Birch (a membranous strobile), x ½.
12. Black Alder (a woody strobile), x ½.
13. Beech (a nut with prickly bur), x ½.
14. Chestnut (a nut with spiny bur), x ½.
15. Red Oak (an immature acorn), x ½.
16. Red Oak (a mature acorn), x ½.
17. Red Mulberry (an aggregate fruit), x ½.

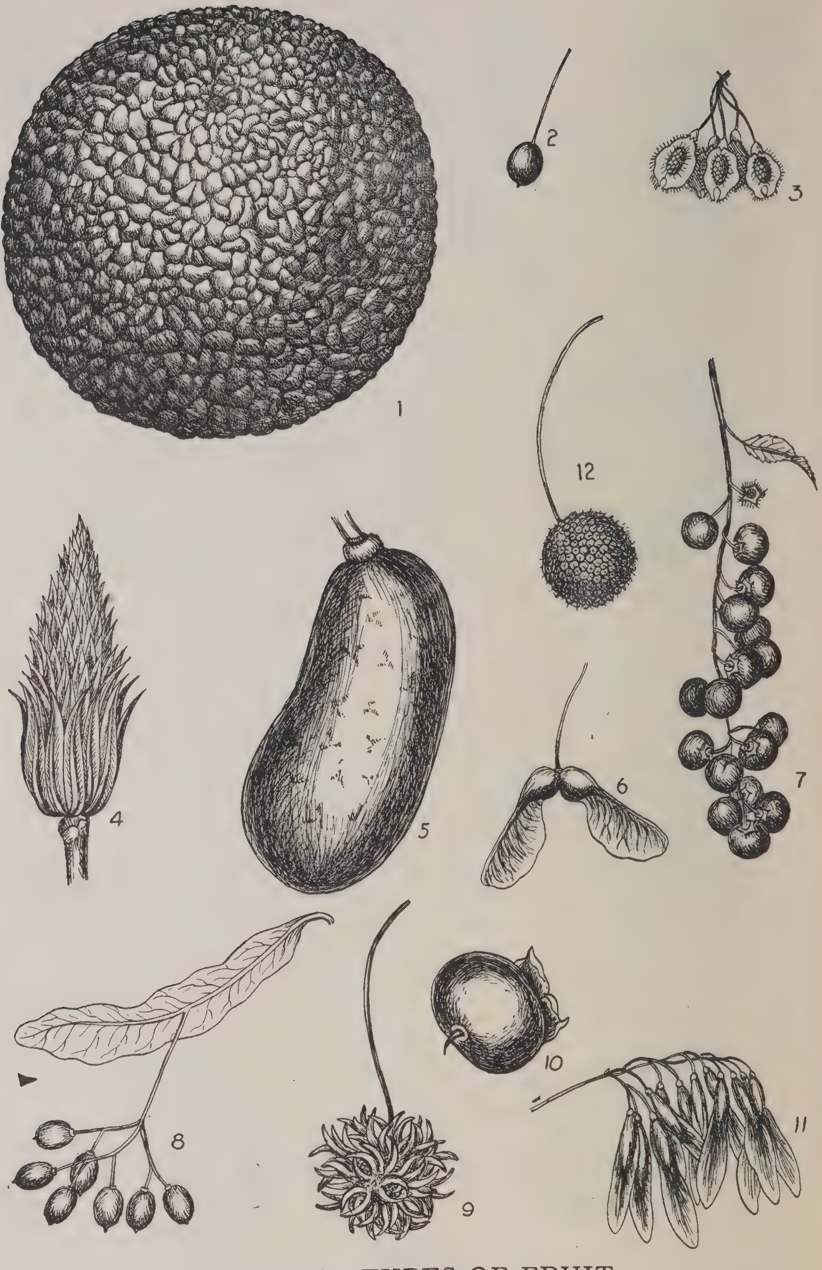

PLATE X. TYPES OF FRUIT

1. Osage Orange (a compound drupe), x ½.
2. Hackberry (a drupe), x ½.
3. American Elm (one-seeded samara), x ½.
4. Tulip Tree (a light brown cone composed of many carpels), x ½.
5. Papaw (a fleshy or pulpy fruit), x ½.
6. Sugar Maple (paired samara), x ½.
7. Wild Black Cherry (a drupe), x ½.
8. Basswood (a nut-like drupe), x ½.
9. Sweet Gum (multicapsular head), x ½.
10. Persimmon (a juicy berry), x ½.
11. White Ash (samaras), x ½.
12. Buttonwood (a head) x ½.

germinate for several months or several years while the seed of a few members of the Pulse family are reported to retain their vitality for more than 125 years.

The mature fruit and seeds of our common trees show a wide variation in their form and structure. Fruits are usually classified on the basis of their texture, as *fleshy fruits* and *dry fruits.* Fleshy fruits are represented by the fruits of such species as Cherries. Papaw, Osage Orange, etc. (Plate X, 1, 2, 5, 7, 10). Dry fruits are those which do not have any flesh or pulp and are represented by the fruits of such species as the Maples, Ashes, and Oaks (Plate IX, 1-16, and Plate X, 3, 4, 6, 8, 9, 11, 12). Fleshy fruits including the stone fruits, are indehiscent. *Indehiscent fruits* (Plate X, 1, 2, 5, 7, 10) are those which do not split apart regularly along certain lines for the liberation of the seeds, while *dehiscent fruits* do split open. Dry fruits may be indehiscent or dehiscent.

The following general types of fruits are commonly recognized: the *pome* (Plate XCII, the *drupe* (Plate X, 7, 10), the *nut* (Plate IX, 7, 8, 9, 14, 15), the *samara* (Plate X, 3, 6, 11), the *follicle* (Plates LXXVI-LXXVIII). the *capsule* (Plate IX, 3. 5) and (Plate X, 9), the *legume* (Plate XCIV-XCVII), the *cone* (Plate IX, 1) and the *collective or aggregate fruits,* (Plate IX, 17). The trees belonging to a single genus usually produce a common type of fruit, but genera belonging to the same family often have an entirely different kind of fruit. This difference of fruit of genera in the same family is shown very clearly in the Nettle family, to which belong the Elms, Hackberry, Osage Orange, and Mulberry, whose fruit are shown on Plate X, 3, 2, 1, and Plate IX, 17.

A wide variation may also occur within the general types mentioned above. The nut is one of the commonest types of fruit found in the forest and will possibly show this wide variation best. Nuts may be small and light, as in the Buttonwood and Birches, or large and heavy as in the Oaks and Chestnut. Light nuts often have appendages attached to them in the form of a membranous wing or a tuft of hairs. The nuts may be produced singly or in strobiles as in the Birches and Alder. They may also be covered or naked. If covered, the covering may be indehiscent and semi-fleshy (Plate IX, 7), or dehiscent and dry (Plate IX, 8). It may also consist of a stalked prickly dehiscent bur (Plate IX, 13), a large spiny dehiscent bur (Plate IX, 14), a bladder-like bag (Plate IX, 10) or a leafy involucre, as in the Common Hazlenuts (Plate LI).

In some trees the seeds are not covered entirely but simplly subtended by a leafy bract (Plate IX, 9). In the Birches and Alder the small winged nuts are produced on 3-lobed bracts which are so arranged that they form a cone-like fruiting body known as a strobile. It is rather hard to classify the fruits of some trees in terms of the types enumerated above, e. g., the fruit of the Basswood has the appearance of a nut, but is in reality a drupe; while the fruit of both the Mountain Ash and the Shad Bush has the appearance of a berry but is actually a pome. A superficial examination is often not sufficient to determine the type of fruit. The fruit of our common Sumachs is a drupe, but is usually covered with acid hairs, so that it is difficult to recognize the type of fruit to which it belongs.

After the fruits and seeds have been produced, it is necessary that they be scattered on a mineral soil upon which they may germinate. The distance over which they are scattered may be short or long, depending upon the nature of the seeds and the agents by which they are dispersed. The fruit as a whole, is usually scattered in the case of indehiscent fruits, while the seeds only are scattered in the case of dehiscent fruits. The drawings on Plates IX and X show various structural modifications of fruits and seeds which aid in their dispersal. The chief dispersal agents are propulsion, man, animals, water, wind, and gravity. The Witch-hazel (Plate LXXXII), is a good example of a tree whose seeds are scattered by mechanical propulsion. Man has been distributing seeds for forest trees intentionally or unintentionally for many centuries, with the result that the forest structure and landscape in many localities have been entirely changed.

Many European and Asiatic species have been planted in America, and many of our native species like the Common Locust and White Pine have a wide distribution abroad. Wind is the most powerful of the dispersal agents. Many seeds have special structural modifications which adapt them to be scattered by the wind. The modifications may be a sac-like envelope (Plate IX, 10), a mat of straight capillary hairs (Plate IX, 4, 6) or a membranous winged, or flattened seed (Plate IX, 2 and Plate X, 3, 6, 11).

Animals also scatter many seeds. A great number are scattered involuntarily by animals, especially such seeds as will hang fast to their bodies. Other fruits are juicy and edible and are often eaten by birds and other animals. A large number of our common birds swallow seeds to get the juicy edible portion surrounding them. These seeds are not injured in passing through their alimentary canal, but in some cases it is thought that the seeds are even benefited. The robins, thrushes, and blue birds eat a large quantity of fleshy fruit and should be regarded as valuable agents for dispersing seeds. The blue jay is also an agent that helps to scatter heavy seeds like chestnuts and acorns. Other animals, especially rodents, are also valuable as seed dispersal agents. Water, while not so important as wind, must still be regarded as an agent of seed dispersal. It transports some seeds over great distances, especially those which will float or are inclosed in bladder-like inclosures like

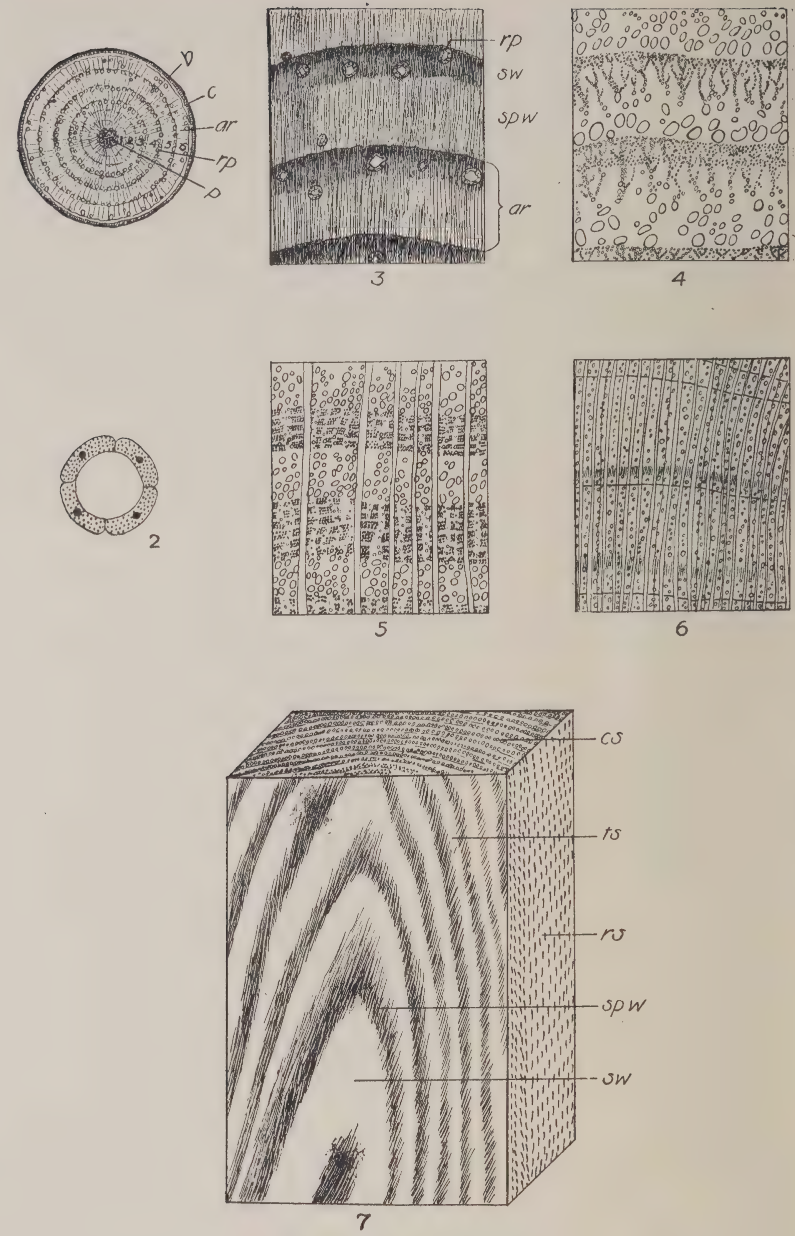

PLATE XI. THE STRUCTURE OF WOOD

1. Cross section of six-year-old stem of White Pine showing (bb) bark, (c) cambium, (ar) annual ring, (p) pith, and (rp) numerous small circular resin passages, natural size.
2. A resin passage with bounding epithelial cells, enlarged.
3. Non-porous wood of White Pine showing (spw) spring wood, (sw) summer wood, (ar) annual ring, and (rp) resin passage, x 3.
4. Ring-porous wood of Chestnut, x 2.
5. Ring-porous wood of Red Oak, showing large medullary rays, x 3.
6. Diffuse-porous wood of Beech, x 4.
7. Block of Chestnut wood showing (cs) cross section, (rs) radial section, (ts) tangential section, (spw) spring wood, and (sw) summer wood, natural size.

the American Hop Hornbeam (Plate IX, 10), or the Bladder Nut, a small shrub very commonly found along our streams. Gravity on slopes, is a minor agent of seed dispersal, but sometimes does effective work, especially with heavy seeded species like Oak and Beech.

9. WOOD:

Wood, next to food, and clothing, is probably the most useful and indispensable material which man uses. It is found in many of the higher plants but becomes of commercial importance only in the spermatophytes or seed-bearing plants. In the timber-producing trees it is found in the roots, branches, and stems. The wood derived from the roots is limited in quantity and inferior in quality. The branches produce wood which, in some respects, very closely resembles that of the stem, but is inferior on account of its smaller size, irregular shape, and more knotty structure. The wood obtained from the stem is of the greatest utility and value on account of its desirable dimensions and satisfactory structure. The stem should not only yield a large quantity of wood but also a superior quality. The quality of wood which a stem will yield depends largely upon its age, inherent tendencies of the species, and its environment during its development. High grade material is usually obtained from the stems of valuable species which have attained a large size, are free from lateral branches, and possess little stem taper. The form and character of the stem are dependent on the environment. A suitable environment may be created by applying the fundamental principles of forestry which will not only increase the productivity of our forests but also the quality of the yield.

In order to identify the different kinds of wood it is necessary to study them from the following three sections: cross, radial, and tangential (Plate XI, 7). An examination of a cross-section of a woody stem will show that the major part of the structure consists of wood which is covered with bark on the outside and has a narrow cylinder of soft tissue known as pith running through the center (Plate XI, 1).

The woody portion of most of our trees, especially the older ones, may be differentiated into two parts on the basis of colors. The central colored part is known as the *heartwood,* while the outer almost colorless part is known as the *sapwood.* A narrow zone of cells located between the sapwood and the bark is known as the *cambium* (Plate XI, 1). All the wood elements have their origin in this zone. For some time after their origin these elements are living, but later they become functionless and die. The sapwood comprises the peripheral zone of wood which lies next to the cambium and contains the only living elements of the wood. The heartwood comprises all the wood inside of this zone. The elements of the latter are dead and usually dark in color. The line of demarcation between the two regions is usually sharp. The width of the sapwood is variable. In some trees like Sassafras it is very narrow, while in other trees like Hickory it is wide. The depth of color of the heartwood is also variable. In some trees like Persimmon it is very dark in color while in other trees like Hemlock there is very little difference in color between the heartwood and sapwood.

The cross-section also shows that the wood is divided into numerous concentric zones or rings. These are known as annual rings since each one usually represents the growth of a season (Plate XI, 1, 3). Certain disturbances like frost, drought, and insect damage may cause the formation of a second ring in the same season. These rings are known as false or fictitious growth rings. Growth rings have a physiological origin. They represent alternating periods of rest and activity, and occur in practically all trees of the temperate region, characterized by an active vegetative period in summer and a resting period in winter. As one approaches the equator the growth rings disappear, since the seasonable changes are not so sharp. Each growth ring may be divided into two parts, the inner, called *early* or *spring wood, and* the outer, called *late* or *summer wood* (Plate XI, 3).

The cross-section further shows radial lines crossing the growth rings at right angles. These are known as *medullary* or *pith* rays, or simply as *rays*. A few of them originate in the pith and extend through the wood into the bark. Such are known as *primary rays*. As the stem increases in size additional rays are necessary. These originate in the wood, extend into the bark and are known as *secondary rays*. The rays are very valuable in distinguishing the wood of many of our common trees since the different woods possess rays which vary in height, width, and structure. The very wide rays of the Oaks enable one to distinguish their wood from that of all other trees. These large rays are a valuable asset to Oak wood since they give rise to the beautiful figure which one finds on some oak furniture and interior finishings. The best figure is obtained by quarter-sawing, i. e., cutting it radially.

The end of a freshly cut log of pine is often covered with small drops of resin, which were given forth from small openings in the wood. These openings are known as *resin ducts* (Plate XI, 1, 2). They are long intercellular channels bounded by a layer of epithelial cells. Their presence in the wood of the Pines, Larches, and Spruces enables one to distinguish them from all other trees. Injury may sometimes stimulate the formation of abnormal resin ducts in woods in which they do not occur normally.

In some woods elements occur, known as vessels, which facilitate the transportation of water in the stem. Their presence or absence and their structure and distribution are among the most valuable characteristics in classifying woods. On the basis of porosity one may divide the woods into three classes, viz: (1) *Ring-porous* or *Unequal Pored, (2) Diffuse-porous or Equal Pored,* and *(3) Non-porous.* Chestnut and Oak wood are excellent examples of the ring-porous class (Plate XI, 4, 5). A zone of large pores is found in the early wood and smaller pores in the late wood. Maple and Beech are common examples of the diffuse-porous class (Plate XI, 6). The pores of this class are approximately of the same size and distributed uniformly throughout the growth ring. Pine and Hemlock are common examples of the non-porous class in which pores are entirely absent. (Plate XI, 3). The wood of this class is also classified as *Homogeneous,* while that with pores is classified as *Heterogenous.*

The various woods possess other characteristics which are valuable in distinguishing them and in using them in the arts. The wood of the different species varies almost as widely as do their flowers, fruits, and leaves, especially with reference to grain, weight, hardness, color, gloss, smell, shrinkage, durability, penetrability, etc. These variable properties and the manifold uses to which the different woods are put are discussed under each kind of tree described in Part II.

PART II

MANUAL OF PENNSYLVANIA TREES

The Identification, Tabulation, and Description of Species

MANUAL OF PENNSYLVANIA TREES

IDENTIFICATION OF SPECIES

Names of Trees:

Trees have two kinds of names, common and scientific. Some trees have only one common name while others may have as many as thirty. The same tree may have one common name in one locality and an entirely different one in another locality. The Pitch Pine is known in some parts of Pennsylvania as Jack Pine and in other parts as Nigger Pine, Black Pine, Torch Pine, or Yellow Pine. The common name given at the top of each descriptive page is the proper common name and the one used throughout this publication for that particular tree. Under the heading "Distinguishing Characteristics," other common names are given.

Since Linnaeus published his "Species Plantarum" in 1753, plants have been known by scientific names. These names, as a rule, consist of two parts, the generic and the specific, as is shown by the following examples: Pinus Strobus, Quercus alba, Fraximus americana, Acer rubrum. The first of generic part refers to the genus and corresponds to a surname. The second or specific part refers not to a group of trees, but to a particular kind and corresponds to the Christian name of a man. The White Pine, Red Pine, and Pitch Pine are different kinds of pines. They belong to the same genus or group and hence have the same generic name, Pinus. Each one, however, is designated by a different specific name. For example, the White Pine is known as Pinus Strobus, the Red Pine as Pinus resinosa, and the Pitch Pine as Pinus rigida. Closely related species are placed in the same genus and closely related genera (plural of genus) in the same family. Such closely related trees as the Pines, Spruces, Firs, and Larches, are placed in the Pine family—Pinaceae.

At the time when plants first were studied seriously the Latin language was the one used most commonly to preserve knowledge The plants consequently were given Latin names. The giving of Latin names to plants and animals has continued down to the present time and no doubt will continue. In the Latin language one finds that plant-names have gender, and that the termination differs in each gender. The specific part of the name must agree in gender with the generic part. The generic name Quercus is femine, hence the Red Oak is known as Quercus rubra while the generic name Acer is neuter, hence the Red Maple is known as Acer rubrum.

The scientific names used in this publication are those found in the Seventh Edition of Gray's Manual of Botany, and are in keeping with the rules of nomenclature laid down at a Congress in Vienna. On account of the present unsettled condition of our nomenclature it is often possible to find a certain species designated by two or more different scientific names, e. g., the Scrub or Bear Oak is known as Quercus ilicifolia, Wang.; Quercus nana, Sarg.; or Quercus pumila, Sudw. The authorized scientific name is given at the top of each descriptive page, and where other scientific names are in common use, they are given as synonyms just below the authorized one or in the description.

The mere knowledge of the names of trees is of little value or satisfaction. The name is simply a means by which to come nearer to the plant. Learning the names of trees serves about the same purpose as learning the names of persons. It is merely an introduction which allows us, in fact often stimulates us, to become more intimately acquainted with their life-processes, associations, environments, and commercial importance.

EXPLANATION OF TERMS AND HEADINGS:

Some readers no doubt will find terms in this publication whose meanings they do not know. Some of the terms have been discussed at length in Part I while others will be defined in a glossary following the description of the species. The description of the trees contained in this publication is subdivided into a number of headings. Most of these headings are discussed at length in Part I. The significance and scope of those headings not discussed in Part I follow at this point. Under the several headings is given such descriptive material which will be of value not only to the student of Dendrology but also to the layman who may know little concerning the characters and habits of trees. The headings have been so selected and treated that one should be able to identify our common trees at all seasons of the year.

Under the heading "Distinguishing Characteristics" are given both general and specific characteristics by which the trees can be recognized. Each tree is usually compared with other rather closely related ones with which it might be confused. The distinguishing characeristics and comparisons are based upon the trees native to Pennsylvania, and consequently do not embrace other closely related trees found outside of the State.

The headings "Range" and "Distribution in Pennsylvania" are often of special importance on account of their identificational value. Many trees have a limit to their geographical distribution in this State, and by knowing this accurately one is often able to identify them by the process of elimination. The Sweet Buckeye and Fetid Buckeye are found only in a few counties in the western part of the State. The Red Pine and Paper Birch are found only in the northern part, while the sweet gum is found only in a few counties in the extreme southeastern part of the State. If one finds a birch tree growing in the forest in the southern part of the State, he can feel cerain that it is not Paper Birch, because this is beyond its southern limit. A coniferous tree growing wild on the top of the South Mountains in Franklin county, Pennsylvania, must be a Pine, Hemlock, or Red Cedar, because no other coniferous trees grow there Further, we know that it cannot be the Red Pine, because it does not extend so far south in the State, and on the basis of habitat we can also be reasonably sure that it is not the Yellow Pine, the Jersey or Scrub Pine, nor the Hemlock, because they very seldom ascend to the tops of the mountains, but usually remain at lower elevations. If Magnolia trees are found in Centre county one can be certain that they are not Laurel Magnolia, (Magnolia virginiana), because it has its western limit of geographical distribution at Caledonia, near Chambersburg, Franklin county.

The habitat also aids considerably in identifying various species. A birch tree found growing upon a mountain slope or mountain top is rarely the River Birch, because the latter usually frequents moist locations like banks of streams and lakes. Chemical composition of the soil also influences distribution. A soil rich in lime seldom has Chestnut growing upon it, at least in stands, while other species seem to thrive upon such soil. No doubt at least 99% of the Cumberland Valley in this State was originally timbered with a heavy forest, but very little of it was Chestnut, while on the adjoining mountain slopes of both the South and North Mountains, Chestnut was the prevailing tree before the Chestnut Blight killed most of it. Just as the Chestnut is essentially a tree of the slopes so the White Oak is essentially one of the bottom lands, and Table Mountain Pine of the mountain tops.

The heading "Importance of the Species" was introduced simply to give general information concerning the forestal significance of the trees and their adaptability for ornamental purposes. This heading is especially important when we realize that of the more than one hundred and twenty-five trees found in this State, fewer than twenty-five are important for timber-producing purposes. Many inferior species which have little present or prospective value have been introduced into this publication, since it was thought just as important to know what not to favor and plant as to know what to plant and give preference. Some trees may not be valuable for the production of timber but they may have a value as shelter to other trees or as soil protectors and soil conservers. Many trees which cannot be regarded as final members of a timber-producing forest may be of temporary value in helping to establish the more valuable permanent species. We should be cautious in eliminating the inferior trees from our forest structure, because they may possess a value which is not evident at the present time. It should be remembered that the trees despised by myself may be prized by my neighbor, and that the trees despised today by my neighbor and myself may be prized by both of us tomorrow. Only general statements are made with reference to the importance of the species. A fuller discussion of this heading may be found in any standard text on General Forestry or Silviculture.

How To Identify The Species And Use The Keys:

Since this publication is intended primarily for laymen and for students who are just beginning the study of trees, the omission of technical terms was thought advisable. We have many trees, some common, others uncommon, which the average layman may not know. He can learn them readily if their distinguishing characteristics are presented to him in ordinary language accompanied by simple and exact drawings. This publication is designed so that the average layman with even a limited knowledge concerning trees can use it and identify the different trees with little, if any, difficulty.

The procedure or method of identification will naturally vary with the individual. One may take material from a tree and compare it with the drawings until he finds one with which it corresponds or to which it fits, and then feel satisfied that he has learned to know the tree. To check himself and to acquire additional information he may read over the descriptive material accompanying each plate. This method of comparison with plates, while the one commonly used by laymen who have little or no working knowledge concerning trees, is laborious and entirely unscientific. A better and yet simple method is the use of an analytic key for the identification of the species. Such keys according to their construction may be simple or complex, serviceable or unserviceable to the average layman. In constructing the keys of this book an attempt was made to make them simple and yet exact, based upon permanent rather than transient, and constant rather than variable characteristics. This publication will no doubt come into the hands of different classes of people, some of whom will recognize at a glance the group to which a certain tree belongs, while others will not have the slightest idea as to what it is. An attempt has been made to satisfy both types of persons. The former can go at once to that portion of the publication where the genus under consideration is treated and by the use of the "Key to the Species" determine the exact tree which they have at hand, while the latter should begin at the "Key to the Families," found on page 69, and use the key until the family to which it belongs is found, then go to the family and use the "Key to the Genera" and the "Key to the Species" until the tree is accurately determined. With a little practice one will find it easy to use such simple keys.

Before attempting to use a key, it is necessary that good material be available. Parts of trees vary considerably, depending upon the environments in which they were developed. An abnormal environment will produce abnormal organs, and if these should be the parts with which you are attempting to identify the particular tree through the use of the keys, it is natural that it would be a difficult task. Structural variations are commonly found in leaves; flowers, fruit, bark, as well as other plant organs. Upon the same tree or even the same branch one may find three or more distinct varieties of leaves. On account of this variation, which often makes identification difficult, abundant material should always be at hand, and especially that which is normal in appearance. The keys are based upon normal material and may not fit variable forms. Only by years of constant and careful study of trees will one be able to distinguish accurately between normal and abnormal material; but by carefully observing and constantly studying the trees one will unconsciously absorb many details concerning them which can be appreciated but not described. This unconscious absorption of appreciable but indescribable detail in trees has a greater significance than we attribute to it at first. The writer, in conducting field work (Fig. 7) for more than ten years in connection with a course in Dendrology given at the Pennsylvania State Forest Academy, found that the students learn to notice many differences between trees, which differences they cannot describe.

The keys are subdivided into three classes, viz: "Key to the Families," "Key to the Genera," and "Key to the Species." The "Key to the Families" is found on page 69, preceding the description of any of the species. The "Key to the Genera" is found under the description of each family which contains more than one genus; and the "Key to the Species" is found under such genera which contain more than one species. The reason for subdividing the keys into three classes instead of combining all three into a general key to genera and species, was the fact that a combined key is often difficult to use on account of its great length, and tedious to operate for those who can recognize the family or genus at a glance but do not know the species. Besides, keys to the genera and keys to the species are more serviceable when placed close to the written description and its accompanying plate than if they precede the descriptive material of all the species.

The three classes of keys are constructed on the same plan; consequently, they can be used in the same manner. To use them it is necessary to make a choice for the most part between two alternatives stated in two paragraphs preceded by the same number. The choice leads to another number or to a family, a genus or a species followed by the page upon which a further description is found. The Sugar Maple may be taken as an example to show how to use the key. Under "Key to the Families," Page 69, we start with 1. We have the choice between trees with "Leaves narrow, needle-like, awl-like, or scale-like, usually persistent except in the genus Larix" and trees with "Leaves broad, flat, rarely five times as long as wide, usually deciduous." We select the latter, which is followed by 2. Under 2 we have the choice between "Leaves opposite or whorled, i. e. 2 or 3 occur at a node" and "Leaves alternate, i. e., only one occurs at a node." We choose the former, which is followed by 3. Here we have the choice between "Leaves or at least most of them three at a node" and "Leaves always two at a node." We select the latter, which is followed by 4. Here we have the choice "Leaves simple" and "Leaves compound." We select the former, which is followed by 5. Here we have the choice between "Leaves palmately lobed" and "Leaves not lobed." We select the former, which is followed by Aceraceae, which is the family name for the Maples. This is followed by a number which indicates the page upon which a further description of the family may be found. At this point it is advisable to check one's self. This can be done by carefully studying the descriptive matter of the family indicated in order to find out if the description corresponds to the specimen under consideration. If the description does not correspond it is advisable to go back to the "Key to the Families" and attempt to find the mistake. If the description does correspond it is reasonable to think that the "Key to the Families" was used correctly. If you feel certain that this is the correct family you should go to the "Key to the Genera," or to the "Key to the Species." No "Key to the Genera," is given under this family because it contains only one genus. Under the "Key to the Genera" and the "Key to the Species" the same method of procedure should be followed that was used under the "Key to the Families." On account of the wide variation between the distinguishing characteristics which are present in summer from those which are present in winter, it has sometimes been found necessary to make two keys, one a summer key and the other a winter key. Two such keys are found under the Maple family. If the material at hand happens to be a spray of leaves of the Sugar Maple, the summer key should be used, and if it happens to be a branchlet with buds, the winter key should be used.

Since the family key which was used to this point was based primarily upon summer characteristics, the winter key will now be used in order to familiarize you with the slight variations which are found between the two keys. Under "Winter Key to the Species," page 197 we start with 1. Under 1 we have the choice between "Buds stalked with few exposed scales" and "Buds sessile or nearly so with 6 or more exposed scales." We select the latter, which is followed by 4. Under 4 we have the choice between "Buds with 8-16 exposed scales, brown, acute, non-collateral; leaf-scars nearly encircle stem" and "Buds with 6-8 exposed scales, red or green, obtuse." We select the former which is followed by Sugar Maple (Acer saccharum), page 200. On this page a full description of the sugar maple is found accompanied by a sketch on the opposite page of the principal characteristics. If the descriptive material and the sketches show that this is the tree under consideration, one may feel satisfied that the key has been used properly. If the description does not correspond it is advisable to go back to the beginning of the key, follow the same procedure indicated above but eliminating the mistake which must have been made. The same method of identification or procedure should be used for every other tree. In a short time one will be familiar enough with the use of the key to identify any tree, and will do so with considerable accuracy.

If you cannot identify the specimen at hand with the aid of the keys, description, and plates, there are still other means which you may use. It may be possible that an institution or a private person in your part of the State possesses an herbarium in which may be found a similar specimen properly labeled. If you can get access to such an herbarium and find that your specimen and the one in the herbarium are alike, and that the herbarium specimen was labeled by a reliable person, it is reasonable to assume that you have identified your specimen correctly. It may also be possible that some one connected with some local educational institution will be able to assist you in identifying the material. All material sent to the Pennsylvania Department of Forestry, Harrisburg, Pa., or to the Dendrological Department of the Pennsylvania State Forest Academy, Mont Alto, Pa., will be identified free of charge. Persons sending material should always aim to send plenty of it. If flowers, leaves, fruits, and bark are obtainable they should all be sent. The wider the range of material the easier and the more accurate the identification will be.

Those who desire to collect and preserve material should proceed in the same manner as one would in making general botanical collections. The dried material may be secured on strong mounting paper. The writer has found the "Riker Specimen Mounts" very satisfactory for preserving and displaying the different parts of trees. Different sizes are obtainable, which allows one to select them in proportion to the size of the material to be preserved.

GENERAL KEY TO THE FAMILIES

Page

1. Leaves narrow, needle-like, awl-like, or scale-like, usually persistent except in the genus Larix, ... Pinaceae 73
1. Leaves broad, flat, rarely five times as long as wide, usually deciduous, ... 2

2. Leaves opposite or whorled, i. e., two or three occur at a node, ... 3
2. Leaves alternate, i. e., only one occurs at a node, ... 10

3. Leaves, or at least most of them, three at a node, ... Bignoniaceae 217
3. Leaves always two at a node, ... 4

4. Leaves simple, ... 5
4. Leaves compound, ... 8

5. Leaves palmately lobed, ... Aceraceae 196
5. Leaves not lobed, ... 6

6. Leaves serrate, ... Viburnum in Caprifoliaceae 224
6. Leaves entire, ... 7

7. Leaves 3-6 inches long with curving parallel veins; bases of leaf stalks enlarged, encircling twigs, ... Cornus in Cornaceae 210
7. Leaves 4-8 inches long without curving parallel veins; bases of leaf stalks do not encircle twigs, ... Chionanthus in Oleaceae 223

8. Leaves palmately compound, ... Sapindaceae 206
8. Leaves pinnately compound, ... 9

9. Leaflets usually 5-11; finely toothed or entire margined, ... Fraxinus in Oleaceae 218
9. Leaflets usually 3, sometimes 5-lobed or coarsely serrate, ..Acer Negundo in Aceraceae 203

10. Leaves simple, ... 11
10. Leaves compound, ... 40

11. Leaves persistent, ... 12
11. Leaves deciduous, ... 14

12. Leaves not armed with spiny teeth, ... 13
9. Leaflets usually 3, sometimes 5-blood or coarsely serrate, ..Acer Negundo in Aceraceae 203

13. Small trees; leaves stout, white silk beneath, not taper pointed; flowers solitary, ... Magnolia virginiana in Magnoliaceae 162
13. Shrubs; leaves leathery, yellowish-green to scurfy beneath, often taper pointed; flowers in clusters, ... Rhododendron and Kalmia in Ericaceae 213

14. Leaves with entire margins, ... 15
14. Leaves with toothed, lobed, or incised margins, ... 23

15. Leaves broadly heart-shaped; flowers reddish-purple, shaped like pea blossoms; fruit a pea-like pod, ... Cercis in Leguminosae 186
15. Leaves not broadly heart-shaped; flowers not shaped like pea blossoms; fruit not a pea-like pod, ... 16

16. Stout axillary spines present; fruit 3-5 inches in diameter, ... Maclura in Urticaceae 159
16. Stout axillary spines absent; fruit smaller, ... 17

17. Leaves decidedly aromatic, often somewhat lobed; twigs spicy-aromatic, mucilaginous if chewed, ... Lauraceae 167
17. Leaves not aromatic or lobed; twigs not spicy-aromatic, nor mucilaginous, ... 18

18. Leaves 2-6 inches long; flowers small except pistillate of Diospyros, not solitary, ... 19
18. Leaves more than 6 inches long; flowers large and solitary, ... 22

19. Leaves bristle-tipped, linear-lanceolate to oblong; pith star-shaped; fruit an acorn, ... Quercus imbricaria and Q. phellos in Fagaceae 152
19. Leaves oval-ovate or obovate, not bristle-tipped; pith not star-shaped; fruit a drupe or a berry, ... 20

Page

20. Leaves thin, clustered at tip of twigs, with prominent curved parallel veins; small trees; twigs greenish streaked with white, ...Cornus alternifolia in Cornaceae 211
20. Leaves thick, not clustered at the tip of twigs; veins not parallel; medium sized trees; twigs not greenish, ...21

21. Leaves 4-6 inches long; leaf petioles with one fibro-vascular bundle; fruit a globular berry 1-1½ inches in diameter, ...Ebenaceae 216
21. Leaves 2-5 inches long; leaf petioles with 3 fibro-vascular bundles; fruit a purple ovoid drupe ¾ of an inch long, ...Nyssa in Cornaceae 212

22. Stipules and stipule-scars encircle twigs; flowers greenish-white or yellowish; fruit Cone-like; twigs often aromatic and bitter, ...Magnoliaceae 161
22. Stipules absent; flowers reddish-purple, ill-smelling; fruit banana-like, edible; twigs not aromatic or bitter, ...Anonaceae 166

23. Leaf margins usually lobed or incised, ...24
23. Leaf margins usually toothed, ...29

24. Leaves star-shaped, ...Liquidambar in Hamamelidaceae 169
24. Leaves not star-shaped, ...25

25. Leaves silvery beneath, ...Populus alba in Salicaceae 100
25. Leaves not silvery beneath, ...26

26. Leaves rough on upper surface, with milky juice, ...Morus in Urticaceae 160
26. Leaves not rough on upper surface, without milky juice, ...27

27. Leaves decidedly aromatic, lobed or entire; twigs spicy-aromatic, mucilaginous, ...Lauraceae 167
27. Leaves not aromatic; twigs not spicy-aromatic nor mucilaginous, ...28

28. Leaves palmately veined; base of leaf hollow; leaf lobes irregularly toothed, ...Platanaceae 181
28. Leaves pinnately veined; base of leaf petioles not hollow; leaf lobes rounded or bristle-pointed, intervening spaces deep or shallow, ...Most species in Fagaceae 129

29. Leaves with an oblique base, ...30
29. Leaves not with an oblique base, ...32

30. Leaves ovate or ovate-oblong; rough on upper surface, Ulmus and Céltis in Urticaceae 157
30. Leaves rounded, heart-shaped, or obovate; smooth on upper surface, ...31

31. Leaves straight-veined with wavy margins; flowers in late autumn; fruit without bract, ...Hamamelis in Hamamelidaceae 168
31. Leaves not straight-veined, deeply and sharply toothed; flowers appear in summer; fruit with bract, ...Tiliaceae 208

33. Leaves not dentate nor coarsely toothed, ...34
32. Leaves not dentate nor coarsely toothed, ...34

33. Leaves with laterally flattened peticles, ...Populus grandidentata in Salicaceae 103
32. Leaves not with laterally flattened peticles, ...Few species in Fagaceae 129

34. Fruit, dry, ...35
34. Fruit, fleshy, ...37

35. Leaves decidedly sour; flowers and fruit produced in racemes resembling the lily of the valley, ...Oxydendrum in Ericaceae 215
35. Leaves not sour; flowers and fruit not produced in racemes, ...36

36. Fruit 1-seeded, nut or samara, subtended by bracts; seeds without tuft of hairs at apex; flowers monoecious; calyx present, ...Betulaceae 117
36. Fruit a small capsule inclosing numerous seeds; seeds with tuft of hairs at apex; flowers dioecious; calyx absent, ...Salicaceae 94

37. Thorns or spine-like spurs present, ...Prunus americana, Pyrus coronaria, and Crataegus sp. in Rosaceae 170
37. Thorns or spine-like spurs not present, ...38

38. Fruit with a single stone, ...Prunus in Rosaceae 171
38. Fruit several-seeded, ...39

39. Leaves heart-shaped or rounded at base, 3-4 inches long; flowers in loose racemes, ...Amelanchier in Rosaceae 180
39. Leaves wedge-shaped or rounded at the base, 4-5 inches long; flowers solitary or in one to few flowered axillary clusters, ...Ilex monticola in Aquifoliaceae 195

Page

40. Leaves with entire margins, ...41
40. Leaves with toothed margins, ...44

41. Leaves even-pinnate, ...Gleditsia and Gymnocladus in Leguminosae 183
41. Leaves odd-pinnate, ...42

42. Leaflets small, elliptic; twigs thorny, ...Robinia in Leguminosae 187
42. Leaflets large, ovate; twigs not thorny, ...43

43. Leaflets 7-21, not toothed at base, without glands, ...
..........Rhus Vernix and R. copallina in Anacardiaceae 189
43. Leaflets 11-41, sometimes with 2-4 blunt teeth at base which have glands on lower side at the point of each tooth, ...Simarubaceae 193

44. Twigs and leaves prickly; leaves twice or thrice compound, ...Araliaceae 205
44. Twigs and leaves not prickly; leaves once compound, ...45

45. Large trees; staminate flowers in aments; fruit a nut, ...Juglandaceae 106
45. Small trees; staminate flowers not in aments; fruit red and fleshy, ...46

46. Leaflets 13-15; sap not milky; branches heavy-tipped, ...Pyrus americana in Rosaceae 179
46. Leaflets 11-31; sap milky; branches heavy-tipped, ...
..........Rhus typhina and R. glabra in Anacardiaceae 189

TABULATION OF TREE GENERA AND TREE SPECIES

Families, Genera, etc.	Species			
			Pennsylvania	
	World	North America	Native	Introduced
Gymnospermae.				
Fam. I. Pinaceae.				
Gen. 1. Pinus,	70	34	6	1
Gen. 2. Larix,	10	3	1	1
Gen. 3. Picea,	19	8	2	2
Gen. 4. Abies,	25	10	1	--------
Gen. 5. Tsuga,	8	4	1	--------
Gen. 6. Chamaecyparis,	6	3	1	--------
Gen. 7. Thuya,	4	2	--------	1
Gen. 8. Juniperus,	40	16	2	--------
Angiospermae.				
Fam. II. Salicaceae.				
Gen. 9. Salix,	175	100	4 (15)*	3
Gen. 10. Populus,	27	19	4	4
Fam. III. Juglandaceae.				
Gen. 11. Juglans,	15	5	2	1
Gen. 12. Carya,	15	15	5 (1)	1
Fam. IV. Betulaceae.				
Gen. 13. Corylus,	7	3	1 (1)	--------
Gen. 14. Ostrya,	4	2	1	--------
Gen. 15. Carpinus,	12	1	1	--------
Gen. 16. Betula,	25	15	5	1
Gen. 17. Alnus,	25	10	1 (1)	--------
Fam. V. Fagaceae.				
Gen. 18. Fagus,	5	1	1	1
Gen. 19. Castanea,	5	3	2	--------
Gen. 20. Quercus,	300	55	16	--------
Fam. VI. Urticaceae.				
Gen. 21. Ulmus,	15	6	2	1
Gen. 22. Celtis,	60	9	1	--------
Gen. 23. Maclura,	1	1	--------	1
Gen. 24. Morus,	10	3	1	1

TABULATION OF TREE GENERA AND TREE SPECIES—Continued

Families, Genera, etc.	Species			
			Pennsylvania	
	World	North America	Native	Introduced
Fam. VII. Magnoliaceae.				
Gen. 25. Magnolia,	25	8	3	--------
Gen. 26. Liriodendron,	1	1	1	--------
Fam. VIII. Anonaceae.				
Gen. 27. Asimina,	8	8	1	--------
Fam. IX. Lauraceae.				
Gen. 28. Sassafras,	2	1	1	--------
Fam. X. Hamamelidaceae.				
Gen. 29. Hamamelis,	3	1	1	-----
Gen. 30. Liquidambar,	3	1	1	------
Fam. XI. Platanaceae.				
Gen. 31. Platanus,	7	3	1	1
Fam. XII. Rosaceae.				
Gen. 32. Pyrus,	40	10	2 (4)	--------
Gen. 33. Amelanchier,	30	23	1 (3)	--------
Gen. 34. Crataegus,	700	60	2 (14)	--------
Gen. 35. Prunus,	90	43	4 (10)	3
Fam. XIII. Leguminosae.				
Gen. 36. Gymnocladus,	2	1	1	----
Gen. 37. Cercis,	7	3	1	--------
Gen. 38. Gleditsia,	11	3	1	--------
Gen. 39. Robinia,	7	7	2	--------
Fam. XIV. Simarubaceae.				
Gen. 40. Ailanthus,	7	1	------	1
Fam. XV. Anacardiaceae.				
Gen. 41. Rhus,	120	16	3 (3)	--------
Fam. XVI. Aquifoliaceae.				
Gen. 42. Ilex,	275	22	2 (3)	--------
Fam. XVII. Aceraceae.				
Gen. 43. Acer,	70	13	6	2
Fam. XVIII. Sapindaceae.				
Gen. 44. Aesculus,	15	7	2	1
Fam. XIX. Tiliaceae.				
Gen. 45. Tilia,	20	8	2	--------
Fam. XX. Araliaceae.				
Gen. 46. Aralia,	30	15	1 (3)	--------
Fam. XXI. Cornaceae.				
Gen. 47. Cornus,	40	15	2 (6)	--------
Gen. 48. Nyssa,	7	5	1	--------
Fam. XXII. Ericaceae.				
Gen. 49. Rhododendron,	100	10	1	--------
Gen. 50. Kalmia,	6	6	1 (2)	--------
Gen. 51. Oxydendrum,	1	1	1	--------
Fam. XXIII. Ebenaceae.				
Gen. 52. Diospyros,	166	2	1	--------
Fam. XXIV. Oleaceae.				
Gen. 53. Fraxinus,	40	16	3 (2)	--------
Gen. 54. Chionanthus,	2	1	1	--------
Fam. XXV. Bignoniaceae.				
Gen. 55. Catalpa,	7	2	------	2
Fam. XXVI. Caprifoliaceae.				
Gen. 56. Viburnum,	100	20	2 (8)	--------
Total,	2,819	661	113 (76)*	29

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*The numbers given in parenthesis refer to species native to Pennsylvania but not described and rarely mentioned in this publication.

THE PINE FAMILY—PINACEAE

There is general agreement that the Pine and Yew families comprise the two divergent branches of the conifers which differ from each other in morphological characters and geographical distribution. The conifers comprise 34 genera and about 300 species, of which number 8 genera with 71 species belong to the Yew family (Taxaceae) and 26 genera with 226 species to the Pine family (Pinaceae). The representatives of these two families are found mainly in temperate regions, both northern where the genus Pinus predominates, and southern where the genus Podocarpus predominates. The geographical distribution of these two families is peculiar since the genera of the northern temperate region are not found in the southern and those of the southern are not found in the northern, excepting the two genera (Heyderia and Podocarpus) both of which cross the tropics. Geological records together with the simplicity of floral structure show us that the members of the Pine family are amongst the oldest living representatives of the ancient arborescent type of vegetation. Morphological evidence seems to point to the belief that the Yew family contains representatives of the most primitive form of conifers and that the genus Pinus in the Pine family contains the most highly specialized forms. The sole representative in Pennsylvania of the family Taxaceae is the American Yew or Ground Hemlock (Taxus canadensis, Marsh). It is a small evergreen shrub seldom exceeding 5 feet in height.

The Pine family is of especial economic value on account of the many commercial products which are obtained from it and the wide range of silvicultural characteristics which its members possess. The annual wood production of the members of this family in the United States far surpasses that of the members of any other family. The wood differs markedly from that of the broad-leaved trees in its greater uniformity, smaller porosity, and less conspicuous medullary rays. Some members of this family yield large quantities of resin, tar, turpentine, and pitch. The fruit of some trees is often of considerable importance as food, and the bark of many is used in the process of tanning.

The members of the Pine family have awl-shaped, scale-shaped, or needle-shaped entire leaves, which are usually persistent. The American Larch is the only coniferous tree native to Pennsylvania which is without foliage in winter. The subjoined key gives the characteristics of the genera commonly found in Pennsylvania:

KEY TO THE GENERA

			Page
1.	Fruit a dry cone with winged seeds,	2	
1.	Fruit a fleshy, round, dark-colored berry with bony seeds,	Juniperus	93
2.	Leaves linear to needle-shaped, not closely overlapping; cone-scales numerous; buds scaly,	3	
2.	Leaves scale-like, closely overlapping; cone-scales few; buds not scaly,	7	
3.	Leaves in bundles of two or more, except on young seedlings and on terminal twigs of Larix,	4	
3.	Leaves solitary,	5	
4.	Leaves persistent, 2-5 in each bundle,	Pinus	74
4.	Leaves deciduous, more than 5 in each cluster,	Larix	83
5.	Leaves flattened, whitish on lower surface,	6	
5.	Leaves 4-angled, needle-shaped,	Picea	84
6.	Leaves with leaf-like stalks, about 2/5 of an inch long; twigs rough; cones small with persistent scales,	Tsuga	89
6.	Leaves without leaf-stalks, usually 4/5 of an inch or more in length; twigs smooth; cones large with deciduous scales,	Abies	90
7.	Leaves less than ⅛ of an inch long; twigs rather slender, not prominently flattened; cones globular with shield-shaped scales which do not overlap,	Chamaecyparis	91
7.	Leaves ⅛ of an inch or more in length; twigs rather prominently flattened; cones elongated with 8-12 overlapping scales,	Thuja	92

THE PINES—PINUS (Tourn.) L.

The genus Pinus comprises more species than any other group belonging to the Pine family. About 70 species of Pine are known in the world, 34 of which are found in North America and 6 in Pennsylvania. Of the 34 species in North America, 13 are found in the eastern part and 21 in the western part. Besides the native Pines a number of introduced species have been planted extensively for ornamental, and locally for forestry purposes. The commonest introduced species are Scotch Pine (Pinus sylvestris, L.) and Austrian Pine (Pinus Laricio var. austriaca, Endl.).

The Pines are adapted to a wide range of climate and soil. Certain species may be found bordering streams and lakes or close to the ocean front while others are confined to mountain tops where they ascend to the timber line. This adaptability makes some of them of considerable economic value even though they may produce no wood of commercial importance. They can be used for afforesting mountain slopes where protection forests are to be formed and maintained, and to reclaim sand barrens.

The Pines are generally trees, rarely shrubs, and of considerable commercial importance on account of the excellent quality and large quantity of major and minor forest products which they yield. Several species of Pine have always been foremost in the estimation of lumberman and the public since the American forests began to be exploited. Until recently more pine lumber was produced annually in the United States than all other kinds of lumber combined. The lumber-producing pine trees have played a very important role in our economic and industrial development. The Pines are distinguished commercially into two classes, Soft Pines and Hard Pines. In the United States there are 12 kinds of Soft Pine, and 22 of Hard Pine. The White Pine is the sole eastern representatives of the Soft Pines, while the Hard Pines have 12 representatives in the eastern and southern United States.

The Pines have three kinds of leaves: seed, primary, and secondary leaves. The primary leaves soon disappear and are seldom seen except on seedlings. The secondary leaves occur singly or in clusters of 2 to 5 and often have a persistent or deciduous sheath surrounding them at the base. They are semicircular or triangular in cross-section, depending upon the number which occur in a cluster. The flowers usually appear in spring. The staminate are borne at the base of the season's growth in clusters and produce enormous quantities of sulphur-like pollen. The pistillate occur near the terminal part of the new shoot or laterally along it, solitary or in whorls of 2-5 or more. Prior to pollination they normally stand erect but after this process has been completed they begin to droop. The wind is the chief agent of pollination. Fertilization takes place about 13 months after pollination. The result of these processes is usually a cone which matures at the end of the second or sometimes the third season. The cones are composed of numerous scales at the base of which the seeds are produced in pairs.

KEY TO THE PINES

Page

1. **Leaves 5 in a sheath, slender, with 1 fibro-vascular bundle, ...P. Strobus** 76
1. **Leaves fewer than 5 in a sheath, usually stout, with 2 fibro-vascular bundles, ...2**

2. **Leaves 3 in a sheath, ...P. rigida** 77
2. **Leaves 2 in a sheath, ...3**

3. **Leaves 5-6 inches long; cones subterminal, scales unarmed, ...P. resinosa** 78
3. **Leaves less than 5 inches long; cones lateral, scales armed with spines or prickles, ..4**

4. **Cones 2½-3½ inches long, armed with stout spines; leaves very sharp-pointed and stiff, ...P. pungens** 79
4. **Cones 3 inches or less in length, armed with prickles; leaves slender to slightly stiff, ..5**

5. **Leaves slender, straight, occasionally 3 in a sheath, 4 inches long or less, P. echinata** 80
5. **Leaves stout, twisted, 1½-3½ inches long, ...6**

6. **Twigs smooth, greenish-purple to grayish-brown; cones at right angles to branch, ...P. virginiana** 81
6. **Twigs rough, dull-grayish yellow; cones pointing backward; bark of upper third of trunk reddish; a European species, ...P. sylvestria** 82

WHITE PINE

Pinus Strobus, Linnaeus

FORM—At present seldom exceeding 3 ft. in diameter and 125 ft. in height, usually 50-90 ft. high and 1½ to 3 ft. in diameter. When grown in dense stands (Figs. 1 and 11) the trees are tall, straight, free from lateral branches for a considerable distance from the ground, have little stem-taper and shallow crowns. When grown in the open (Fig. 53, specimen on left), it has much stem-taper, is relatively low, often forked, covered with persistent lateral branches almost to the ground which make it attractive ornamentally but of low commercial value.

BARK—On young branches, thin, smooth, greenish-brown; later scaly and darker. On old trees thick, dark gray, and divided by long and shallow fissures into broad longitudinal ridges (See Fig. 63).

TWIGS—Slender, flexible, at first hairy, slightly roughened by raised leaf-scars. New growth at first light green and erect. During first winter light brown in color, less erect in position, very resinous if punctured.

BUDS—In terminal cluster, ovate-oblong, sharp-pointed, with numerous brown, long-pointed and overlapping scales. Apical bud ¼-½ of an inch long. Lateral buds about ¼ of an inch long.

LEAVES—Light green when young and bluish-green, soft, flexible, 2½-5 inches long when mature; persist usually until end of second season, occur in clusters of five, are triangular in cross-section, contain one fibro-vascular bundle, have finely serrate edges and are surrounded at the base by a deciduous sheath.

FLOWERS—Appear about May. Staminate flowers clustered at base of new growth of season, yellow, oval, about 1/3 of an inch long. Pistillate flowers are solitary or in small groups, lateral along new growth, pinkish-purple, cylindrical, about ¼ of an inch long.

FRUIT—A cone maturing in two seasons, 5-10 inches long, drooping, stalked, slightly curved, and covered with thin unarmed scales without thickened apex. Seeds are winged, ¼ of an inch long, dark brown in color on both sides and mottled with black spots.

WOOD—Non-porous; resinous, soft, straight-grained, easily worked, light brown except sapwood which may be almost white. Weighs 24 lbs. per cubic foot. Formerly used for a wider range of purposes than any other native species and adapted for practically all uses except where strength, hardness, flexibility and durability in contact with soil are required.

DISTINGUISHING CHARACTERISTICS—The White Pine is the only Pine native to eastern North America which has soft, flexible, bluish-green needles in clusters of five. The lateral branches, usually 3-7 in a whorl, are arranged in distinct horizontal layers. The cones are 5-10 inches long, long-stalked, and their cone-scales are thin, flat, and unarmed.

RANGE—Newfoundland to Manitoba on the north, south through northern states to Pennsylvania and along the Allegheny Mountains to Georgia, and southwest to Iowa.

DISTRIBUTION IN PENNSYLVANIA—Common in the mountainous portion of the State. Originally formed heavy stands especially in the central and northern parts of the State. Sometimes pure but usually mixed with other species. Found sparingly in the southwestern and southeastern parts where it is usually limited to cool ravines and north slopes. Rarely found at present in valleys like the Cumberland, Lancaster, Chester, lower Lehigh and lower Delaware.

HABITAT—Prefers a fertile, moist, well-drained soil, but will grow well on dry sandy soils and gravelly slopes. Common on banks of streams, river flats, in hollows and ravines, but rarely found in swamps. Any habitat in its natural range will be favorable to its development except swamps and ridges exposed to severe winds.

IMPORTANCE OF THE SPECIES—White Pine is one of the most important timber trees of the United States. It is native to America but was introduced into England by Lord Weymouth in 1705 and shortly afterwards into Germany where it is no longer regarded an exotic tree but a naturalized member of the German forest. White Pine can be recommended for forestry purposes, because it may be successfully regenerated naturally and planted with an assurance that it will grow well. More than 21, 000,000 White Pine trees have been planted on the State forests of Pennsylvania. Most of them are growing well and promise a big yield of valuable wood. It adapts itself to a great variety of soil conditions, is a rapid grower, is very attractive ornamentally, and will thrive in pure or mixed stands; but the latter are best on account of less danger from disease, better natural pruning, and earlier financial returns from thinnings.

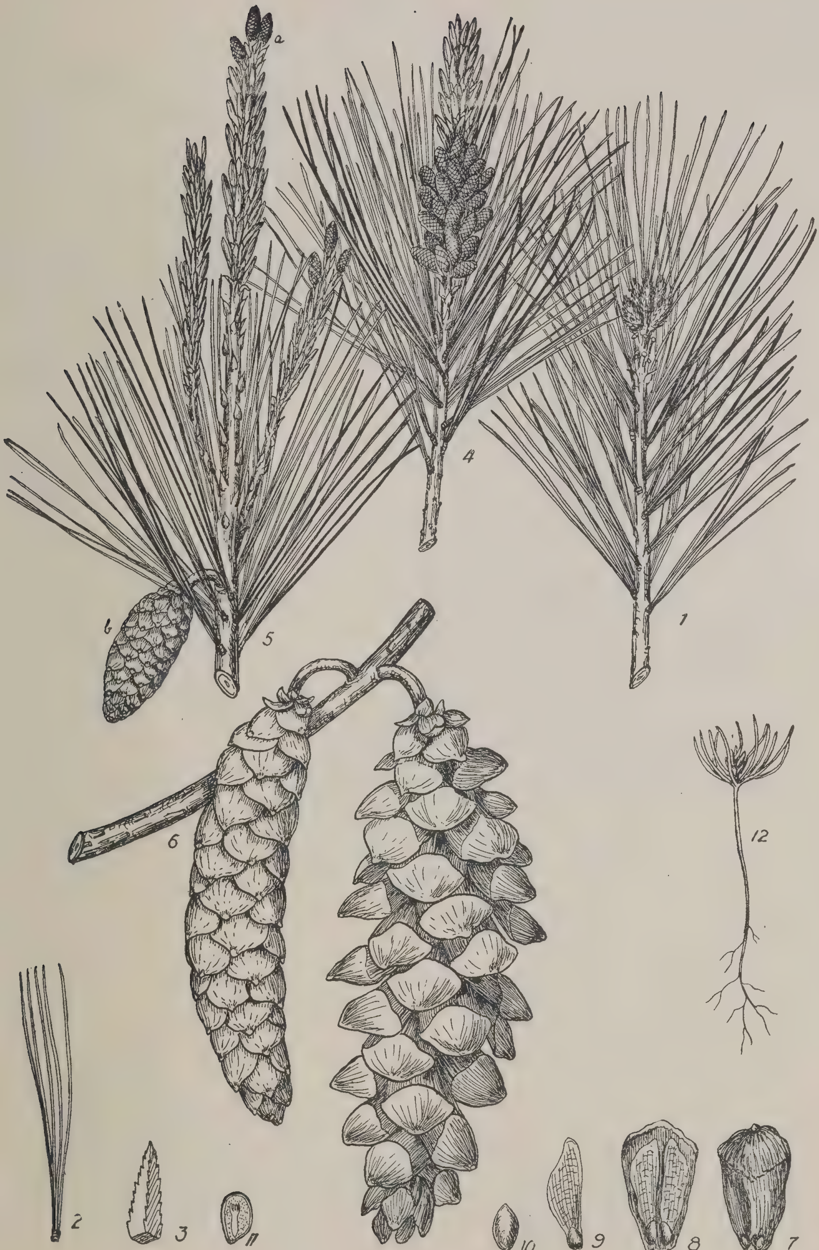

PLATE XII. WHITE PINE

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of five needles, x ½.
3. Tip of needle with sharply serrate margin, enlarged.
4. Branch with staminate flowers, x ½.
5. Branch with (a) pistillate flowers on new growth (b) one-year old cone on last season's growth, x ½.
6. Branch with an open and a closed cone, x ½.
7. Lower side of a cone scale, x ½.
8. Upper side of a cone scale with two winged seeds, x ½.
9. A winged seed, x ½.
10. A seed, natural size.
11. Section of seed with embryo, natural size.
12. A seedling, x ½.

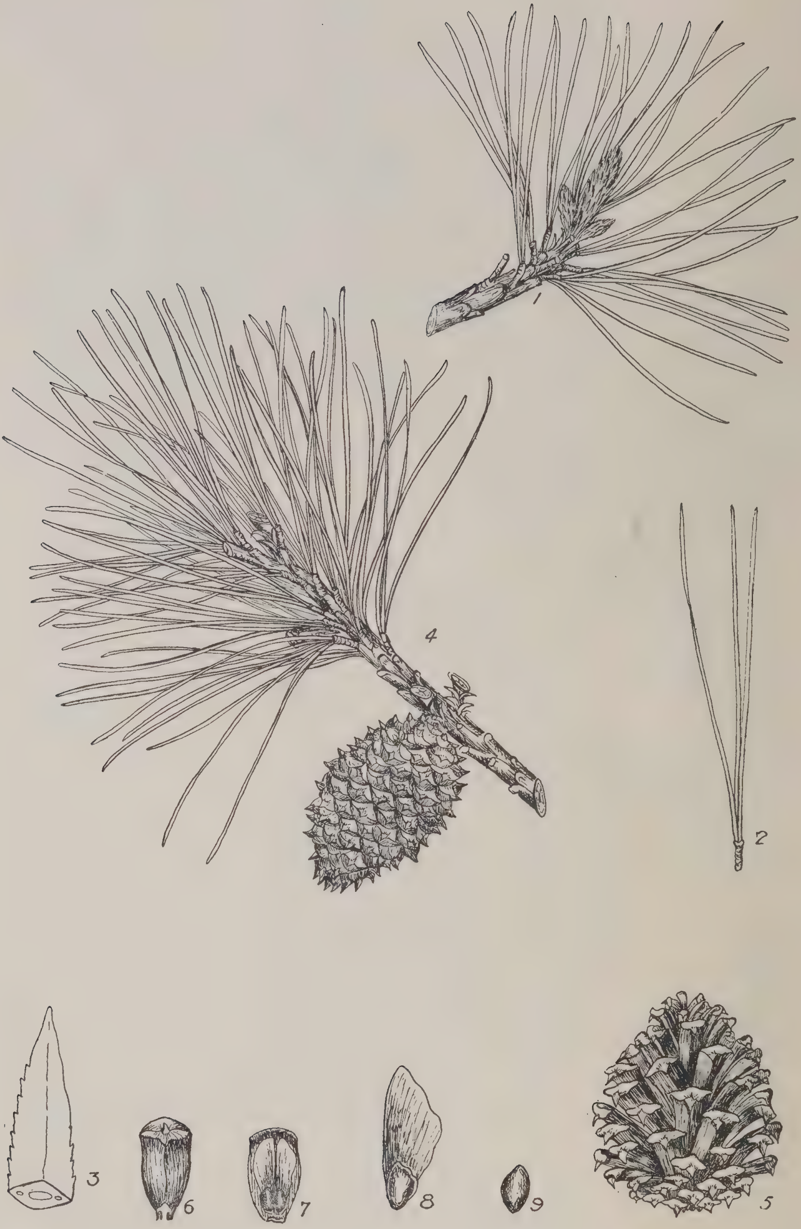

PLATE XIII. PITCH PINE

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of three needles, x ½.
3. Tip of a needle with serrate margin and angular cross-section, enlarged,
4. Branch with needles and a closed cone, x ½.
5. An open cone, x ½.
6. Lower side of a cone scale, x ½.
7. Upper side of a cone scale with two winged seeds, x ½.
8. A winged seed, natural size.
9. A seed, natural size.

PITCH PINE

Pinus rigida, Miller

FORM—Usually attains a height of 40-50 ft. and a diameter of 1-2 ft. and seldom exceeds 70-80 ft. in height and 3½ ft. in diameter. Trunk rather tapering except in occasional pure and closed stands. Open grown trees have an irregular wide pyramidal crown. Branches numerous, irregular, gnarled, often drooping, and covered by small plate-like scales and numerous persistent cones. Crown is often so irregular and scraggy in appearance that it becomes picturesque.

BARK—On young branches green and smooth soon becoming yellowish, later grayish-brown and roughened by persistent bases of the bud-scales. On young trunks roughened with reddish-brown scales, with age becoming rougher through deep furrows and flat ridges which separate into thin reddish-brown scales. The scales sometimes appear black, whence the name Nigger Pine. See Fig. 65.

TWIGS—Stout, brittle, smooth, brown and very rough on account of persistent elevated and decurrent bases upon which the leaf-clusters rested.

BUDS—Ovate, sharp-pointed, often resinous, ¼-¾ of an inch long, covered with imbricated, loose, brown, and shining scales.

LEAVES—In sheathed clusters of 3, stout, rigid, dull-pointed, closely and sharply toothed, at first light green, later yellowish-green, 2½-5 inches long, with stomata on all sides, and contain 2 fibro-vascular bundles and 3-7 resin-ducts.

FLOWERS—Appear in April or May. Staminate flowers clustered at base of new growth of season, are cylindrical, yellow, ½ of an inch long, and produce an enormous amount of pollen. Pistillate flowers are solitary or clustered, lateral on new growth, at first green, later tinged with red.

FRUIT—A cone maturing in 2 seasons, 1½-3½ inches long, sessile or short-stalked, ovate, occurs solitary or whorled, often stands at right angles to the branch, and persists for 10 or more years. Cone scales thickened at apex, armed with short rigid recurved prickles. Seeds winged, dull or glossy black, sometimes mottled with gray or red dots.

WOOD—Non-porous; resinous, light, brittle, coarse-grained, rather durable, brownish-red with abundant lighter sapwood. Weighs 32 lbs. per cubic foot. Used for railroad ties, charcoal, mine props, fuel, sometimes for construction timber and lumber.

DISTINGUISHING CHARACTERISTICS—The Pitch Pine, also known as Jack Pine, Hard Pine, Yellow Pine, Torch Pine, Black Pine, and Nigger Pine is the only native Pine of Pennsylvania with leaves regularly in sheathed clusters of 3. The Yellow or Short-leaf Pine may occasionally have the needles in clusters of 3, but usually 2. Pitch Pine has a very irregular and scraggy appearance due to the dead and gnarled branches which are often covered with clusters of persistent cones. The bark is thick and irregularly fissured with intervening flat ridges which separate into thin reddish-brown sometimes black scales. Trunks are often fire scarred. Such trunks are frequently covered with distinctive dense mats or clusters of leaves and short branches.

RANGE—New Brunswick to Lake Ontario on the north, south to Virginia and along mountains to Georgia, and west to western New York, Kentucky and Tennessee.

DISTRIBUTION IN PENNSYLVANIA—Found in practically all parts of the State, but rare and local in the southeastern and southwestern parts. Occurs in excellent pure stands at the base of the South Mountains in Franklin county, and in Center, Huntingdon, and Pike counties. Sparse in the rich agricultural sections of the State. In many regions it occurs only as a scattered tree mixed with hardwoods.

HABITAT—Common on dry, burned-over areas, sterile plains, gravelly slopes, rocky cliffs, and sometimes found in swamps. In the glaciated area it is common on rocky glacial soil.

IMPORTANCE OF THE SPECIES—From a commercial point of view Pitch Pine is not so important as the White Pine or the Red Pine, but it is gradually growing in importance since new uses are found for the wood and prices of other woods are rising. Silviculturally it is valuable on account of its adaptability to poor soil and its fire resisting qualities. These qualities recommend it for reforestng neglected or fire endangered lands on mountain slopes as well as low sandy areas. It may not be the tree ultimately desired upon the area, but may act as a shelter during the establishment of a stand of a more valuable species. More than 1,600,000 Pitch Pine trees have been planted on the State Forests of Pennsylvania.

RED PINE

Pinus resinosa, Aiton

FORM—Usually from 50-75 ft. in height with a diameter of 2-3 ft. but reaching a maximum height of 140 ft. with a diameter of 4½ ft. The largest Red Pine trees in Pennsylvania probably stand on a mountain top below Driftwood in Cameron County. In closed stands trunk is straight, tall, slightly-tapering, and free from lateral branches for a considerable distance from the base while in open stands the lateral branches extend nearly to the base and the trunk is often branched and strongly-tapered. Crown usually broad, irregular, pyramidal, with dark green foliage tufted at the ends of the branches. See Fig. 61.

BARK—Reddish-brown, ¾-1¼ inches thick, divided by shallow furrows into broad flat ridges which peel off in thin scales. See Fig. 64.

TWIGS—Stout, slightly roughened by persistent bases of bud-scales; at first yellowish-brown, later reddish-brown.

BUDS—Ovoid, pointed, ¼-¾ of an inch long. Bud-scales brown, thin, loose, and fringed on the margin.

LEAVES—In sheathed clusters of 2, 4-6 inches long, dark green, rather slender and flexible, sharp, persisting for 3-5 years.

FLOWERS—Appear in May. Staminate flowers are about ½ of an inch long, occur in dense clusters at base of growth of season, have dark purple anthers. Pistillate flowers are subterminal, 2 to 3 in a whorl, short-stalked, scarlet.

FRUIT—A cone about 2 inches long, nearly sessile, light brown, ovate-conical when closed and somewhat spherical when open, persisting until the following year. Cone-scales chestnut-brown with ends slightly thickened and transversely ridged but not armed with spines or prickles.

WOOD—Non-porous; resinous, hard, pale red, with thin light sapwood, and very conspicuous medullary rays. Weighs 30 lbs. per cubic foot. Green wood is very heavy and will sink. Used for heavy construction, piles, masts, in general for nearly all other purposes for which White Pine is used.

DISTINGUISHING CHARACTERISTICS—The Red Pine, also known as Norway Pine, is essentially a northern tree and is the only native Pine of Pennsylvania with needles 4-6 inches long, sheathed in clusters of 2. Its cones are about 2 inches long, subterminal, and bear scales which are not armed with spines or prickles. The needles are borne in tufts at the ends of branches.

RANGE—Distinctly a northern tree occurring from Nova Scotia and Quebec on the north to Pennsylvania on the south, and west to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Found only in the northern part of the State. Its southern limit in the central part of the State is about at Williamsport. A small stand was recently located near Selinsgrove in Snyder county. In the eastern and western parts it does not come as far south as in the central part. Found in Bradford, Cameron, Center, Clinton, Lackawanna, Lycoming, Luzerne, McKean, Potter, Snyder, Susquehanna, Tioga, Wayne, and Wyoming counties. The York Water Company has planted 290,000 Red Pine on the watershed about its reservoir, and 1,100,000 have been set out by the Pennsylvania Department of Forestry.

HABITAT—Usually found on dry gravelly ridges, mountain-tops, and dry sandy plains. Rare on flat lands with wet clay soil.

IMPORTANCE OF THE SPECIES—The Red Pine is a valuable timber tree usually mixed with other trees, but occasionally found in dense pure stands in Minnesota. This tree is remarkably well adapted to natural seed regeneration since it produces a great quantity of light, large-winged seeds which are readily disseminated by the wind, and does not shed all its seeds at the same time. It readily adapts itself to variable conditions, is attractive ornamentally, and should be regenerated naturally where seed trees are at hand and artificially upon such areas where it will thrive.

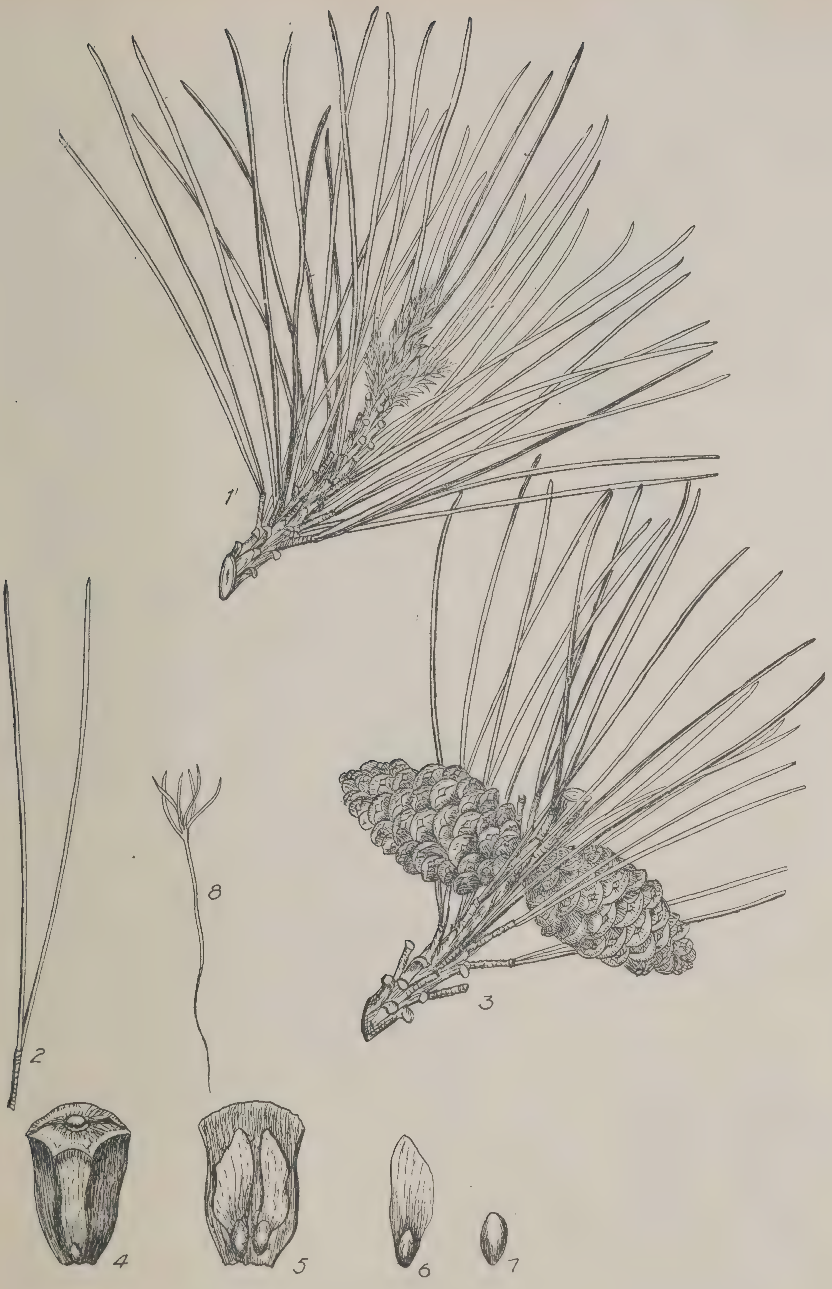

PLATE XIV. RED PINE

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of two needles, x ½.
3. Branch with needles and cones, x ½.
4. Lower side of an unarmed cone scale, natural size.
5. Upper side of a cone scale with two winged seeds, natural size.
6. A winged seed, natural size.
7. A seed, natural size.
8. A seedling, x ½.

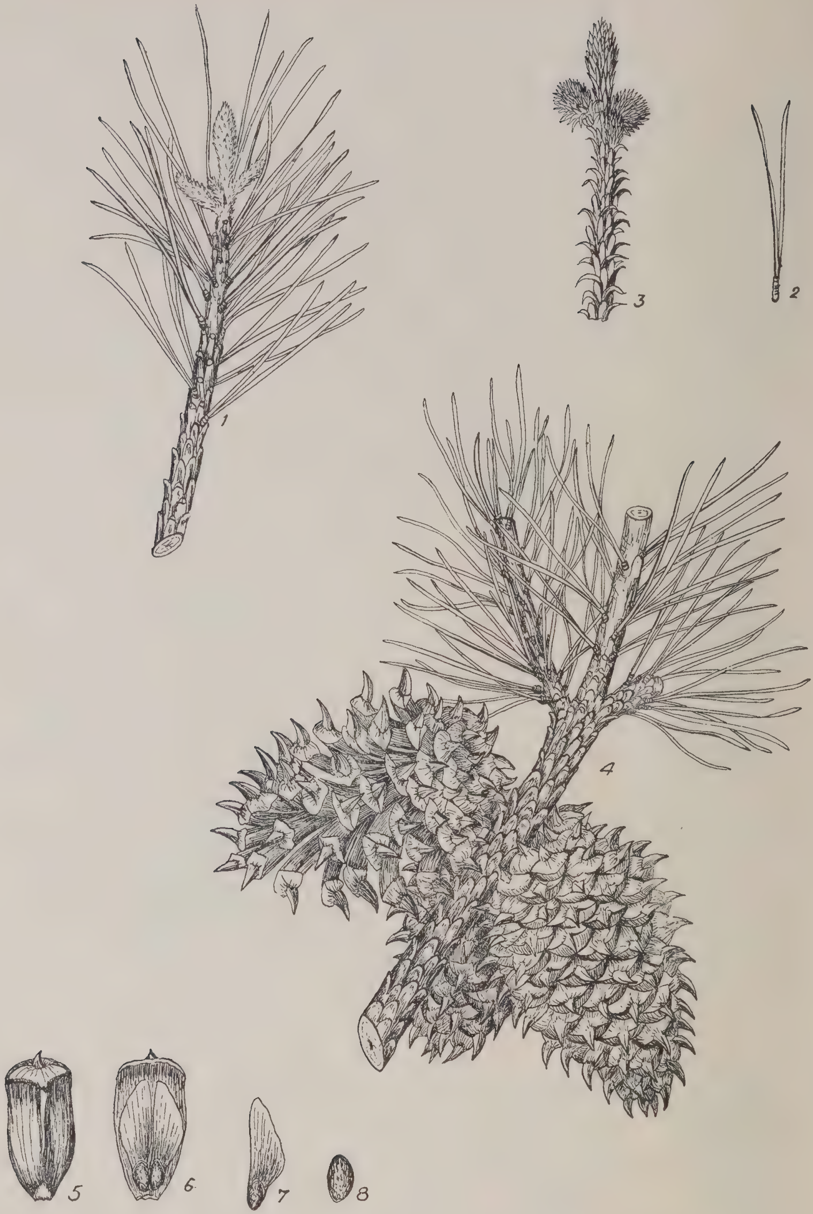

PLATE XV. TABLE MOUNTAIN PINE

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of two stiff, twisted and sharp-pointed needles, x ½.
3. New growth of two pistillate flowers, x ½.
4. Branch with needles and a whorl of three cones, x ½.
5. Lower view of a cone scale with a spine, x ½.
6. Upper view of a cone scale with two winged seeds, x ½.
7. A winged seed, x ½.
8. A seed, natural size.

TABLE MOUNTAIN PINE

Pinus pungens, Lambert

FORM—Usually attains a height of 30-40 ft. with a diameter of 1-2 ft., but when crowded in a closed forest stand it may attain a height of 60 ft. with a diameter of 2½-3 ft. What was probably the largest Table Mountain Pine tree ever recorded in the world grew near Mont Alto, Franklin county, Pennsylvania. It was 73 feet high and 23 inches in diameter. Crown in closed stands shallow, irregular, narrow, and round-topped. In the open the trunk is short, bearing short lateral branches, the upper ones ascending and the lower ones drooping. Often the tree is covered with branches to the base of the trunk so that the lower branches lie prostrate on the ground. See Fig. 62.

BARK—Dark reddish-brown, ½-¾ of an inch thick, roughened by shallow fissures into irregular plates which peel off in thin films.

TWIGS—Stout, rather brittle, at first smooth and light orange to purplish, later rather rough and dark brown.

BUDS—Resinous, narrowly elliptical, blunt-pointed, covered with overlapping brown scales. Terminal buds about ½-¾ of an inch long, the lateral shorter.

LEAVES—In clusters of 2 surrounded by a persistent sheath, 2-4 inches long, light bluish-green, stout, very stiff, more or less twisted, very sharp-pointed, tufted at the end of the branches, persisting for 2-3 years.

FLOWERS—Appear in April or May. Staminate flowers occur in long, loose clusters at the base of the growth of the season; have yellow anthers. Pistillate flowers appear laterally along new growth in whorls of 2 to 5 or 7, and are very short and stout-stalked.

FRUIT—A cone 3-4 inches long, sessile, oblique at the base, in whorls of 2 to 5 or 7 or even more, light brown, short ovoid, persisting for 15 or more years but shedding seeds soon after maturity. Cone-scales, especially those near base, much thickened and provided with a strong curved spine. A branch 7 years old, 1½ inches thick at the thickest end and 3½ ft. long bore 36 cones. Trees 5 years old and 2-3 ft. tall can be found bearing young cones.

WOOD—Non-porus; resinous, brittle, coarse-grained, pale reddish-brown with light sapwood. Weighs 31 lbs. per cubic foot. Used primarily for fuel and charcoal, and occasionally sawed into lumber.

DISTINGUISHING CHARACTERISTICS—The Table Mountain Pine, also known as Prickly Cone Pine, and Poverty Pine, can readily be distinguished by its coarse and massive cones armed with very stout curved spines. The cones appear usually in whorls of 3, 5, 7 or more and persist for many years. The stout, twisted, and very sharp-pointed needles are also characteristic. The growth is rather slow and the terminal shoots are stout, stiff, and rough.

RANGE—From Pennsylvania and New Jersey along the mountains to North Carolina and northern Georgia.

DISTRIBUTION IN PENNSYLVANIA—Sparse to abundant upon the mountains in the south-central part of the State and extends northeast on the mountains to Schuylkill county. It is primarily a southern tree occurring in pure stands on the mountains in Franklin county. Common on some mountains in Adams, Berks, Blair, Centre, Clinton, Dauphin, Franklin, Fulton, Huntingdon, Mifflin, Perry, Schuylkill, and Union counties. Outposts also occur in Lancaster and York counties.

HABITAT—Commonly found on dry, rocky, and gravelly slopes. Occasionally found at the base of the mountains on somewhat moist clayey soil. A few years ago the writer found a considerable number of Table Mountain Pine trees on an island of the Susquehanna river in southern Pennsylvania at an elevation of about 200 feet above sea level. The roots were washed continuously by water—by no means a typical habitat for this tree. Another unusual location was found by the writer in the center of the Cumberland Valley on a shale embankment along the East Branch of the Conococheague Creek, midway between Greencastle and Williamson, in Franklin County.

IMPORTANCE OF THE SPECIES—The lumber of Table Mountain Pine is of little commercial importance on account of its small size and numerous knots which it contains. It is a very aggressive tree and is adapted for the regeneration of worn-out fields as well as to protect rocky slopes and prominences from erosion. It occasionally reaches a size which will yield lumber. Trees 20 inches in diameter and with a clear length of 25 feet are not uncommon locally in the southern part of the State.

YELLOW PINE

Pinus echinata, Miller

FORM—Attains height of 80-100 ft. occasionally 120 ft. and diameter of 2-3 ft., occasionally 4 ft. Crown shallow, wide, pyramidal or rounded. Trunk clean, tall, and slightly tapering. Lateral branches relatively light, very brittle, intolerant of shade, and consequently drop off very early producing the clean, tall, and stately trunk. See Figs. 12 and 53.

BARK—On young branches at first pale green and smooth, later reddish-brown and scaly. On old trees dark brown tinged with cinnamon-red, often ¾-1 inch thick, broken by distinct fissures into irregular, often rectangular plates which peel off very readily into numerous thin filmy scales. See Fig. 66.

TWIGS—Stout, brittle, slightly rough, at first often covered with glaucous bloom, later becoming reddish-brown.

BUDS—Ovoid, dull-pointed, covered with sharp-pointed dark brown scales.

LEAVES—Usually in clusters of 2, sometimes 3 or even 4, slender, flexible, faintly toothed, abruptly pointed, dark bluish-green, 3-4 inches long, surrounded by persistent sheath, and persisting for 2-5 years.

FLOWERS—Appear in April or May. Staminate flowers clustered at base of new growth of season, nearly sessile, pale purple. Pistillate flowers are rarely solitary, but usually 2-4 in a whorl just below end of new growth, borne on stout erect stems, and pale rose colored.

FRUIT—A cone maturing in 2 seasons. One year old cones short-stalked, oval, about 1/6-¼ of an inch long. Mature cones short-stalked or sessile, conic when closed and ovoid when open, 1½-2 inches long, often persisting for 2 or more years. Cone-scales have slightly enlarged ends terminated by weak or deciduous prickles. Seeds small, triangular, 3/16 of an inch long, ⅛ of an inch wide, pale brown mottled with black spots.

WOOD—Non-porous; resinous, hard, strong, with distinct spring and summer wood, yellowish or dark brown. Weighs 38 lbs. per cubic foot. It furnishes the most desirable of the yellow pine lumber of commerce and is largely manufactured into lumber used for general construction and carpentry.

DISTINGUISHING CHARACTERISTICS—The Yellow Pine, also known as Short-leaf Pine, is rarely found in the northern part of Pennsylvania, which will prevent confusing it with the Red Pine native only to the northern part of the State. It can be distinguished from the other species of Pine found growing with it in this State by its rather slender flexible leaves in sheathed clusters of 2, sometimes 3 or 4, its conic cones with scales terminated by weak or deciduous prickles, its brittle branchlets, and its clean, stately, slightly-tapering trunk, the bark of which is marked off by deep furrows into irregular or rectangular plates which peel off very readily into numerous thin film-like scales. The needles are shorter and slenderer than those of the Pitch Pine.

RANGE—Southeastern New York and northern Pennsylvania to Florida, westward to Illinois, Kansas and southeastern Texas.

DISTRIBUTION IN PENNSYLVANIA—This is essentially a southern species but extends into Pennsylvania. It is usually mixed with hardwoods. Large specimens of it are found in the George tract (Fig. 12) near Mont Alto, Franklin county. It is also reported on the Cook tract in Jefferson and Forest counties, and in Fulton, Juniata, Lancaster, Perry, Lycoming, Montgomery, and Union counties.

HABITAT—Common on poor, sandy, or clayey soil. It is a tree of the plains and foothills. Reaches its optinum development on the uplands and undulating plains west of the Mississippi. In the east it is usually mixed wth hardwoods.

IMPORTANCE OF THE SPECIES—Next to the Long-leaf Pine, the Yellow Pine is the most important of the Southern Pines. It is destined to play a very important role in future forest management in the regions where the conditions of growth are favorable, on account of its economic and commercial value. This species, on account of the ease with which it regenerates naturally, requires little assistance from the hands of the forester. It can be planted upon favorable situations anywhere in Pennsylvania.

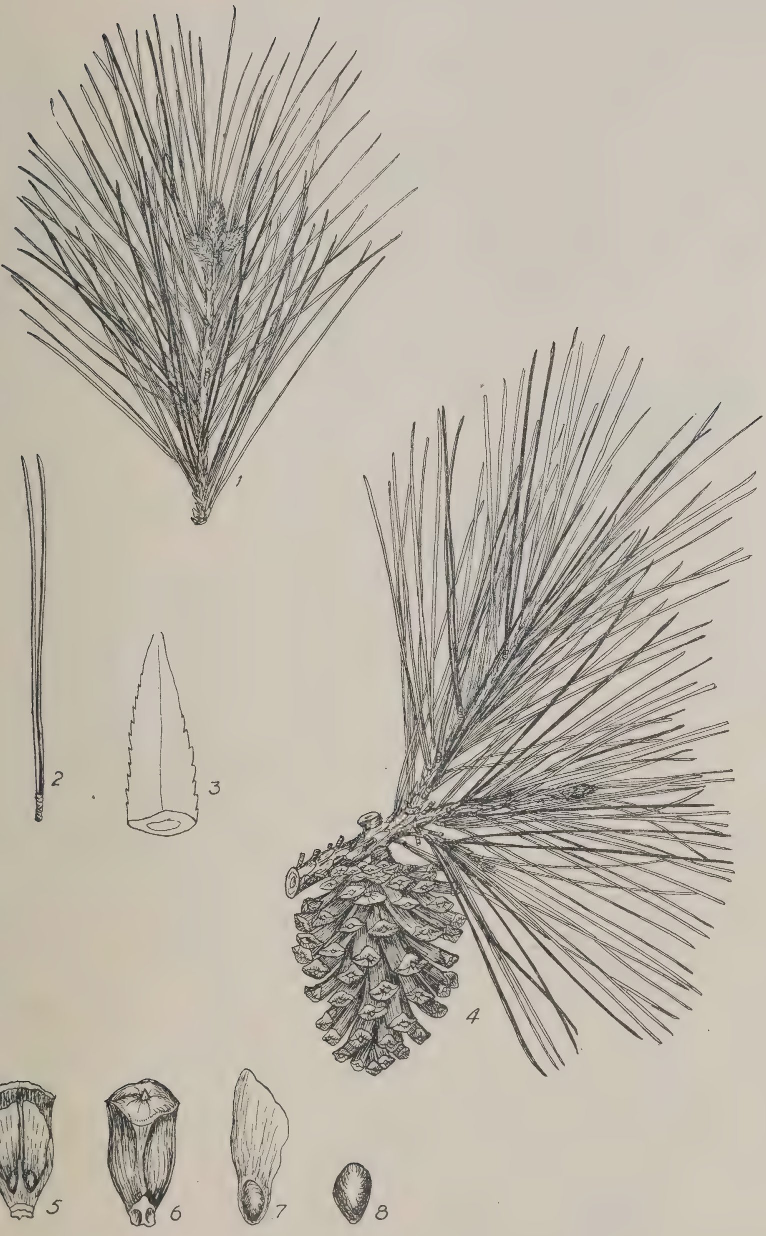

PLATE XVI. YELLOW PINE

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of two needles, x ½.
3. Tip of a needle with finely serrate margin, enlarged.
4. Branch with needles and an open cone, x ½.
5. Upper side of a cone scale with two winged seeds, x ⅓.
6. Lower side of a cone scale, x ⅓.
7. A winged seed, natural size.
8. A seed, slightly enlarged.

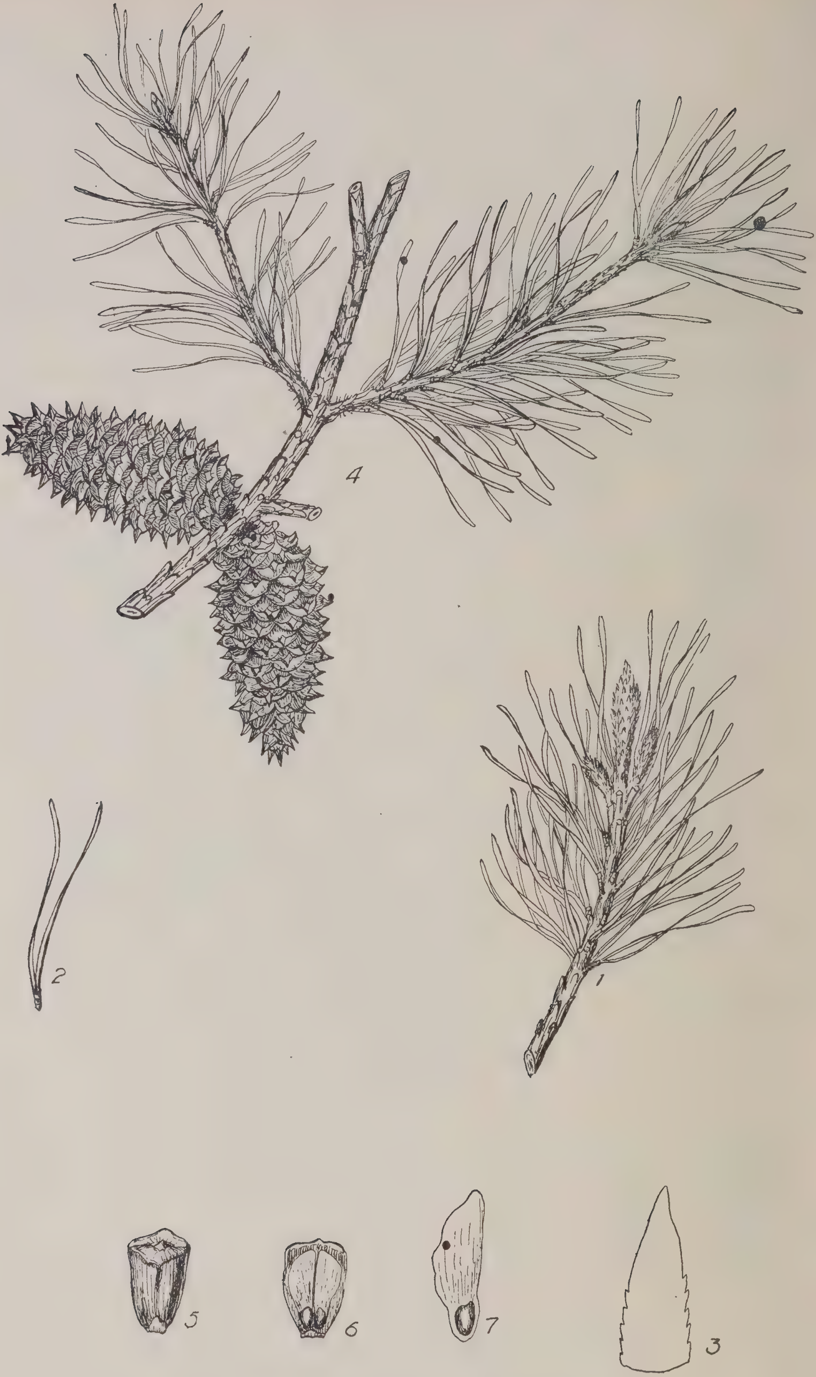

PLATE XVII. JERSEY OR SCRUB PINE

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of two needles, x ½.
3. Tip of a needle with finely serrate margin, enlarged.
4. Branch with needles and closed cones, x ½.
5. Lower side of a cone scale, x ½.
6. Upper side of a cone scale with two winged seeds, x ½.
7. A winged seed natural size.

JERSEY OR SCRUB PINE

Pinus virginiana, Miller

FORM—Usually attains a height of 30-40 ft. with a diameter of 18 inches, but reaches larger dimensions, especially in Indiana. Trunk usually short since the long horizontal or pendulous branches cover it almost to the base. Young trees have a pyramidal form while older trees develop a rather flat-topped conic form.

BARK—On the trunk ¼-½ of an inch thick, dark reddish-brown, shallowly fissured into small flat plates separating into thin film-like scales. Smoother than that of our other native Pines. See Fig. 67.

TWIGS—Slender, tough, flexible, rather smooth, at first greenish-purple and covered with a glaucous bloom, later light grayish-brown.

BUDS—Ovate, sharp-pointed, ¼-½ of an inch long, covered with overlapping, sharp-pointed, brown scales.

LEAVES—In clusters of 2 with persistent sheath, 1½-3 inches long, twisted, bright green, rather stout, fragrant, sharply thick-pointed, toothed, divergent above the sheath, and closely dispersed on twigs.

FLOWERS—Appear in April or May. Staminate flowers are crowded at base of growth of season, 1/3 of an inch long, oblong, with yellowish-brown anthers. Pistillate flowers appear near the middle of the season's growth and are long-stalked, sub-globose, solitary, or few in a whorl.

FRUIT—A cone, 2-3 inches long, usually sessile, sometimes slightly curved, conical when closed and ovoid when open, seldom persisting for more than 3 or 4 years. Cone-scales thin, nearly flat, thickened at apex, and terminated with a prickle. Seeds rounded, 1/3 of an inch long, ⅛ of an inch wide, and pale brown.

WOOD—Non-porous; slightly resinous, light, soft, brittle, pale orange, with very light sapwood. Weighs 33 lbs. per cubic foot. Used for fuel, and to some extent for railroad ties, mine props and lumber.

DISTINGUISHING CHARACTERISTICS—The Jersey or Scrub Pine can be distinguished by its short, twisted, and divergent needles distributed in pairs along the smooth, purple, slender, often curved, and tough branchlets. The cones are small, with thin rather flat scales and provided with slender prickles. The divergent and twisted needles closely dispersed on the twigs give rather a disheveled appearance to them, and permits one to distinguish this tree at a distance since the light of the background is diffused through it so evenly. The bark is smoother than in the other native Pines, and upon older specimens decidedly reddish in color.

RANGE—Southeastern New York and Pennsylvania, south to Georgia and Alabama, west to Indiana and Kentucky.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the southern and central part of the State. It is primarily a southern tree but extends as far north as Allegheny county in the western part, Clinton and Lycoming counties in the central part, and Northampton county in the eastern part. In Franklin county it is usually found at the base of the mountains, seldom ascending the mountains or extending into the limestone part of the Cumberland Valley. It is, however, common on the shale hills, which occur locally throughout the valley, and is numerous southwest of Greencastle. Very common in the abandoned fields of central and northern Pennsylvania.

HABITAT—Common on light sandy or poor rock soil. It is common on some of the sand barrens of New Jersey, and on exhausted farm land and cut-over areas.

IMPORTANCE OF THE SPECIES—It is rarely of much importance as a timber tree on account of its small size. While it is of little commercial importance still it is of considerable economic value as a reforester of worn-out and neglected lands. It has reclaimed many abandoned fields in Clinton county. On the country estate of Col. Henry W. Shoemaker near McElhattan in Clinton county occurs the most northern heavy stand of this tree. Some of the trees are 30 inches in diameter and clear of branches for 45 feet from the ground. For ornamental purposes it has been used very little, other trees being preferred.

SCOTCH PINE

Pinus sylvestris, Linnaeus

FORM—Usually 70 ft. high with a diameter of 1½-3 ft. but may attain a height of 120 ft. with a diameter of 3-5 ft. In the United States it is usually planted in the open and consequently it has a short, clean, often branched trunk bearing numerous, more or less drooping lateral branches. Trees in closed stands produce straight and clean trunks with little taper and a short compact crown. At a distance it resembles the Pitch Pine.

BARK—On the trunk scaly and peels off in flakes from the ridges which are separated by long shallow fissures. Lower part of the trunk is rough while the upper is rather smooth and distinctly reddish in color. Outside bark on the lower trunk is grayish-brown while the inner is reddish-brown.

TWIGS—Fairly stout, brittle, dark yellowish-gray, smooth, not glossy.

BUDS—Ovate, blunt-pointed, brown, often somewhat resinous.

LEAVES—In sheathed clusters of 2, 1½-3½ inches long, bluish-green, or dark green, stout, twisted, semi-circular in cross-section and containing 2 fibro-vascular bundles.

FLOWERS—Appear in April or May. Staminate flowers are clustered on the lower half of this season's growth, ovate, scarcely 2/5 of an inch long. Pistillate flowers appear singly or in 2s just below the terminal buds of this season's growth, are ovoid and short-stalked.

FRUIT—A cone 1½-2½ inches long, short-stalked, conic-oblong, solitary or in 2s usually pointing backward and grayish or reddish in color.

WOOD—Non-porous; resinous, light, reddish-brown with thick light yellowish or reddish sapwood. Used for general construction, lumber, railroad ties, hop-poles, grape vine poles and fuel.

DISTINGUISHING CHARACTERISTICS—The Scotch Pine, a native of Europe, may be distinguished from the other Pines of Pennsylvania by the reddish appearance of the upper part of the trunk and adjoining branches, the bluish-green leaves 1½-3½ inches long, and the backward-pointing cones, which occur near the terminal part of a season's growth. It has rougher twigs than the Jersey or Scrub Pine, shorter needles than the Red Pine, stouter needles than the Yellow Pine, and blunter-pointed needles than the Table Mountain Pine.

RANGE—Not native to America. Abroad it extends over the greater part of Europe and part of western Asia. In the United States it can be planted over a large area in the northeastern states, the lake states, and some of the prairie states. Planted in practically all parts of this State for reforestation and for ornamental purposes.

HABITAT—Scotch Pine is indifferent to soil requirements, water, heat of summer, and cold of winter. It will grow on all classes of soil, even dry, sterile sand. The rate of growth depends more on the physical structure than the chemical composition of the soil. It prefers deep, well-drained sandy loam. It is very intolerant of shade.

IMPORTANCE OF THE SPECIES—The Scotch Pine is a very important tree in its native and adopted European home. It plays a prominent role in the forest structure of parts of Germany, such as the sandy plains along the Rhine and the large sandy areas of northern and eastern Prussia. Excellent forests of this species can be seen in Germany, but it is not necessary to introduce it into the United States extensively for forestry purposes. It grows very rapidly in youth, but later more slowly. For a fuller discussion of Scotch Pine consult December, 1917 number of Forest Leaves. More than 5,000,000 Scotch Pine seedlings have been planted and distributed by the Pennsylvania Department of Forestry.

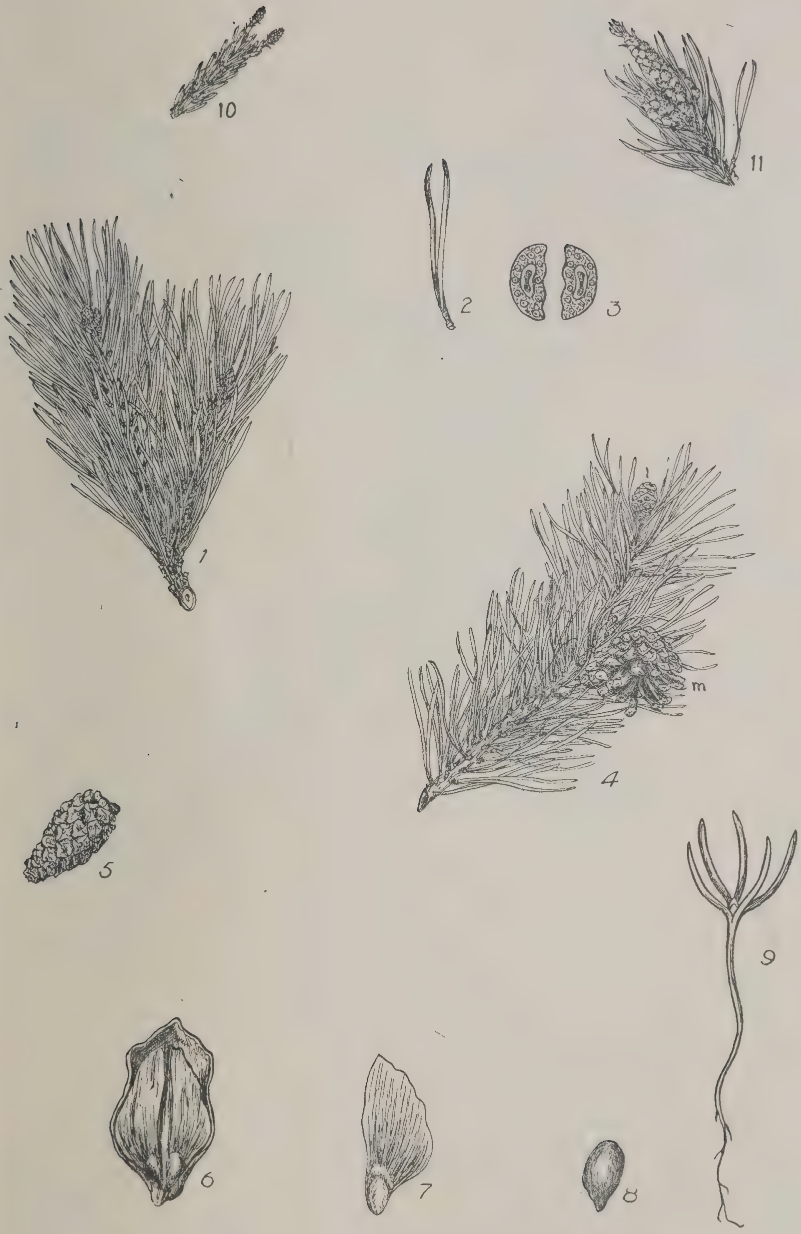

PLATE XVIII. SCOTCH PINE

1. A branch with needles and buds, x ⅓.
2. A cluster of two needles, x ⅓.
3. Cross section of two needles, enlarged.
4. Branch with needles; i, immature cone; m, mature cone, x ⅓.
5. A closed cone, x ⅓.
6. A cone scale with two winged seeds, enlarged.
7. A winged seed, enlarged.
8. A seed, enlarged.
9. A seedling, natural size.
10. A small portion of a branch with two pistillate flowers, x ⅓.
11. A branch with a cluster of staminate flowers at the base of the new growth, x ⅓.

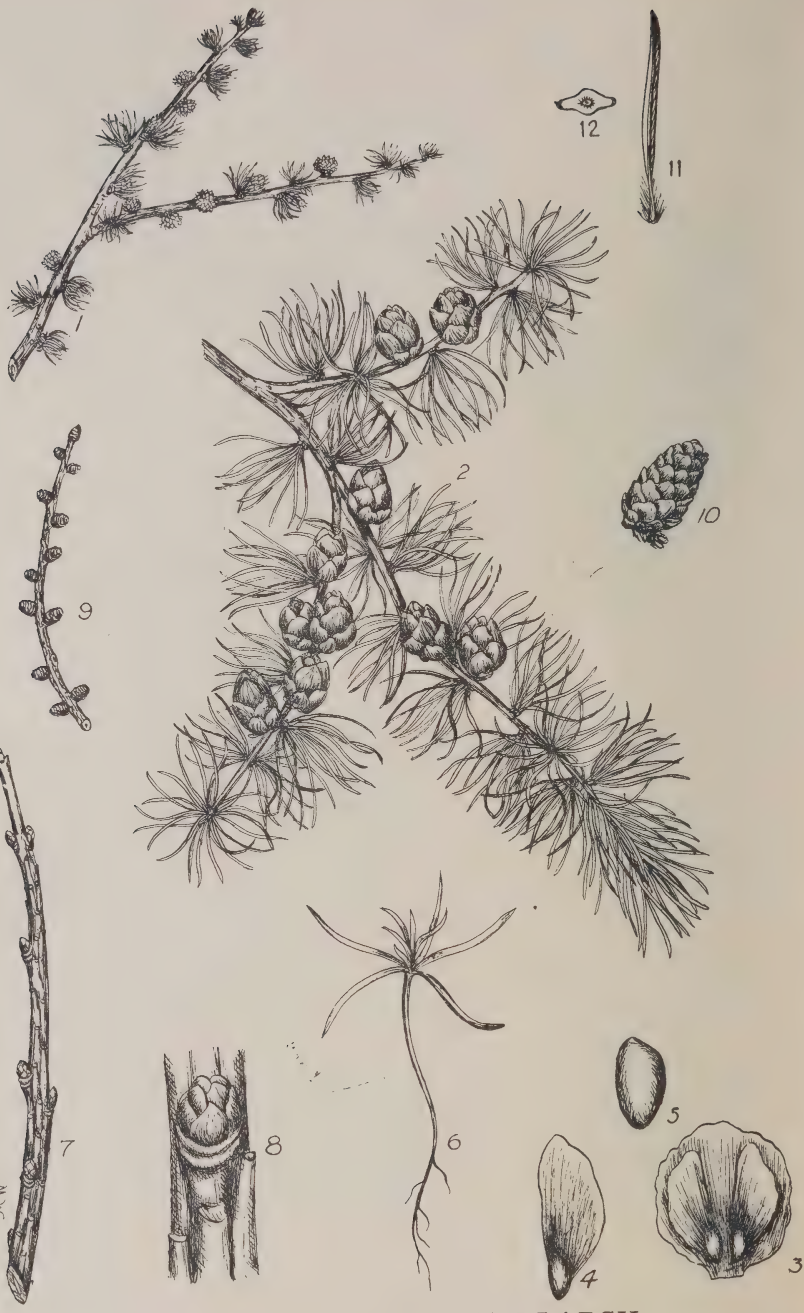

PLATE XIX. AMERICAN LARCH

1. Branch with developing leaves and flowers, x ½.
2. Branch with needles (clustered and solitary) and fruit, x ½.
3. A cone scale with two winged seeds, enlarged.
4. A winged seed, enlarged.
5. A seed, enlarged.
6. A seedling, enlarged.
7. Terminal portion of a winter branch, natural size.
8. Section of a winter branch, enlarged.
9. A winter branch with lateral spurs, x ½.
10. A cone of European Larch (Larix decidua), x ½.
11. Leaf of European Larch, x ½.
12. Cross-section of leaf of European Larch, enlarged.

AMERICAN LARCH

Larix larcina, (Du Roi) Koch

GENUS DESCRIPTION—This genus Larix comprises about 10 species found in the cooler portion of the northern hemisphere and occasionally extends beyond the Article Circle. Of the 10 known species 3 are found in North America, 2 in the western part and 1, a transcontinental species. The latter is found in Pennsylvania. The Larches all 'shed their leaves every fall and the following spring put out new ones. This deciduous habit gives the trees an appearance in winter of dead conifers. A single foreign species known as the European Larch (Larix decidua Mill.), is planted extensively for ornamental purposes, and lately to a limited extent for forestry purposes. It is a very rapid grower and will thrive on drier and less fertile soil than our native eastern species. It should not be planted pure but mixed with other species. Mixture with Norway Spruce, however, is not recommended.

FORM—A medium-sized tree usually attaining a height of 30-60 ft. with a diameter of 1-2½ ft., but may reach a height of 110 ft. with a diameter of 3 ft. Shrubby towards the northern limits of its range. Trunk straight, continuous, and bearing rather straight, slender, and slightly ascending branches which form in the open a narrow pyramidal crown.

BARK—On main trunk rather close but roughened by small, thin roundish, reddish-brown scales. On the smaller branches it is smooth, thin bluish-gray. See Fig. 68.

TWIGS—At first covered with a bloom, slender, smooth, becoming dull brown, covered with numerous, short, stout, spur-like lateral branches.

BUDS—Occur at end of spur-like lateral branches and along last season's growth; small, about 2/5 of an inch long, globose, smooth, shining, and dark red in color.

LEAVES—Linear, triangular in cross-section, ¾-1¼ inches long, rounded above, keeled below, and deciduous. They occur either along terminal shoots or clustered in fascicles on short spur-like lateral branches.

LEAF-SCARS—Distinctly decurrent, very small, triangular in outline, and contain a single bundle-scar.

FLOWERS—Appear about May with the leaves. Staminate flowers sessile, sub-globose, yellow, and borne on one or two-year-old branches. Pistillate flowers short-stalked, oblong, reddish, and borne on lateral branches of previous year.

FRUIT—An ovoid cone, light brown with blunt apex, ½-¾ of an inch long, consisting of about 20 scales which are largest near the middle and smaller towards the base and apex. Seeds winged, about ⅛ of an inch long and mature in one year.

WOOD—Non-porous; somewhat resinous, very heavy, hard, strong, very durable in contact with the soil; heartwood bright red; sapwood narrow and white. Weight 39 lbs. per cubic foot. Used for fence posts, telegraph poles, railroad ties, and in ship building.

DISTINGUISHING CHARACTERISTICS—The American Larch, also known as Tamarack, Hackmatack, and Black Larch, is the only native deciduous conifer of Pennsylvania. In winter it is without leaves and presents the appearance of a dead tree. The leading branches wtih their spur-like lateral branches bearing tufts of linear leaves in summer and small reddish buds in winter, are characteristic. It bears little resemblance to any of our native conifers but does resemble the European Larch (Larix decidua Mill.). The latter may be distinguished by its larger cones, stouter and yellower twigs, and longer and more abundant leaves.

RANGE—Newfoundland south to Preston county, West Virginia, west to Minnesota and the Rocky Mountains, through British Columbia to Alaska. It is one of only a few forest trees whose natural range extends across the continent.

DISTRIBUTION IN PENNSYLVANIA—Found locally in moist locations in Carbon, Centre, Clinton, Crawford, Lackawanna, Lycoming, Mercer, Monroe, Pike, Potter, Susquehanna, Tioga and Warren counties.

HABITAT—Frequents swamps, banks of lakes and rivers, but also thrives on well-drained hillsides. It is one of the most boreal of eastern conifers, extending north beyond the Arctic Circle to the limit of tree growth. On account of its wide range it experiences a great range in climate. Each varied habitat seems to stamp the tree with some peculiarity which is evident in its form and structure. It requires abundant light throughout life.

IMPORTANCE OF THE SPECIES—The American Larch is essentially a northern tree but grows naturally in parts of Pennsylvania and may be grown artificially in other parts. The tree is especially adapted for wet locations and hence may be used where other more valuable trees will not grow. Seedlings can be grown in the nursery and transplanted with success, but they should not be planted in dry locations. It has a very destructive enemy in a saw fly, which has recently destroyed a large number of trees over an extensive territory in the northeast.

THE SPRUCES—PICEA, Link

The Spruces are evergreen trees with stiff, often sharp-pointed needles which persist for 7-10 years. All the Spruces found in eastern North America and all but two species found in western North America have four-sided needles. The two exceptions have flattened needles and bear stomata, commonly known as breathing pores, only on the upper surface, while the species with four-sided needles have stomata on all sides. The needles are spirally arranged on the branches and are not stalked but borne on decurrent projections of the bark known as *sterigmata*. The staminate and pistillate flowers occur separate on the same tree, usually on the same branch. The staminate, which bear the pollen, are yellow to red in color, cylindrical in outline, and open lengthwise. The pistillate, which develop into cones, are erect, cylindrical, short-stalked, and pale yellow to scarlet in color. The cones mature at the end of one season and are always drooping and usually cylindrical to ovate in outline. The cones usually fall entire during the first winter or sometimes persist for a few years. They consist of numerous persistent cone-scales which are thin and unarmed, and consequently stand in strong contrast with the thick, usually armed, cone-scales of the Pines. The cone-scales are largest near the center and decrease in size towards the apex and the base. The fertile scales bear two winged seeds on each cone-scale. The seeds are usually light and bear a rather large wing, by means of which they are scattered over great distances by the wind.

The trunks of the Spruces are straight, continuous, and taper gradually to the top. The lumbermen for a long time looked unfavorably upon the Spruces but owing to changed economic conditions and a more thorough knowledge of their technical value, these same trees are now considered among our most important commercial forest trees. Their wood is now considered amongst the most important of the northern hemisphere and especially adapted for the manufacture of paper pulp.

The spruce forests of North America for a long time remained practically untouched, but are now being exploited on a gigantic scale. The march of forest destruction is very rapid since an enormous supply is required for the paper pulp industry. In order to supply this growing demand and not diminish the available supply of spruce wood it is necessary that proper and systematic treatment be given to the existing spruce areas, since we cannot hope to import a supply sufficient to satisfy our demand.

This genus Picea comprises about 18 to 20 known species, of which number 8 are found in North America, 3 in the eastern part and 5 in the western part. Two of the eastern species are native to Pennsylvania. In addition to the two spruces native to Pennsylvania, 2 introduced species are commonly planted for ornamental purposes, viz: the Norway Spruce (Picea Abies (L.) (Karst.), and Colorado Blue Spruce (Picea pungens Engelm.). The subjoined key will distinguish the Spruces commonly found in Pennsylvania.

KEY TO THE SPRUCES

Page

1. Cones cylindrical, over 3 inches long; terminal part of lateral branchlets pendulous; leaves slender, dark green, glossy, sharp-pointed, ... **P. Abies** 88

1. Cones ovate to oblong, less than 3 inches long; terminal part of lateral branchlets not decidedly pendulous; leaves rather stout, often blunt-pointed, ...2

2. Leaves dark yellowish-green; cones elongated-ovoid with clear brown, entire-margined scales, ... **P. rubra** 86

2. Leaves bluish-green; cones short-ovoid; often persisting beyond first season; cone-scales dull, grayish brown with jagged margin, ... **P. mariana** 87

RED SPRUCE

Picea rubra, (Du Roi) Dietrich

FORM—A medium-sized tree usually reaching a height of 70-80 ft. with a diameter of 1½-2 ft., but may attain a height of 110 ft. with a diameter of 3 ft. Trunk straight, continuous, slightly tapering, bearing long persistent lateral branches which are horizontal in the middle, ascending above and drooping below. Crown narrow, conical in form.

BARK—Up to ½ of an inch in thickness and roughened by irregular, thin, close, reddish-brown scales.

TWIGS—Rough, slender, light brown to dark brown, covered with pale to black hairs.

BUDS—Ovoid, sharp-pointed, ¼-⅓ of an inch long, covered by overlapping sharp-pointed reddish-brown scales.

LEAVES—About ½-⅝ of an inch long, 1/16 of an inch wide, 4 sided, yellowish green, rounded at apex, crowded, and pointing outward in all directions on twig, without real leaf-stalks but raised on decurrent projections of bark, known as sterigmata.

LEAF-SCARS—Small, with a single bundle-scar, borne on decurrent projections of bark.

FLOWERS—Appear in April or May. Staminate and pistillate flowers occur separate, but appear on the same tree. Staminate oval, almost sessile, reddish in color. Pistillate cylindrical, ¾ of an inch long, and consist of rounded thin scales.

FRUIT—A cone about 1¼-2 inches long, elongated-ovoid, short-stalked, maturing at the end of first season; cone-scales rounded, reddish-brown, with entire margin.

WOOD—Non-porous; light, soft, not strong, pale in color, tinged with red, with resin passages present. Weighs 28 lbs. per cubic foot. Used in the manufacture of paper pulp, sounding boards for musical instruments, and construction.

DISTINGUISHING CHARACTERISTICS—The Red Spruce, sometimes known as the Spruce Pine, can be distinguished from the Black Spruce by its larger cones, which usually fall during the first winter, while those of the latter usually persist for a longer time. The cone-scales of the Red Spruce are a clear brown and entire-margined, while those of the Black Spruce are grayish-brown and more jagged. The needles of the Red Spruce are dark green to yellowish-green, while those of the Black Spruce are bluish-green. It can readily be distinguished from the White Spruce and the Colorado Blue Spruce by its hairy twigs, and from the Norway Spruce by its much smaller cones and absence of long pendulous branchlets.

RANGE—Newfoundland to Pennsylvania and south along the Alleghenies to Georgia, west to Minnesota. Heavy stands occur upon the high mountains of western North Carolina.

DISTRIBUTION IN PENNSYLVANIA—Frequents the swamps of Monroe, Pike, Carbon, Wayne, Lackawanna, Luzerne, and probably a few other nearby counties.

HABITAT—Common upon mountain slopes and well drained upland, but also found on mountain tops and on the margin of swamps and streams.

IMPORTANCE OF THE SPECIES—The Red Spruce is one of the most important trees which supply the wood used in the manufacture of paper pulp. Where natural regeneration is possible this tree deserves to be developed, especially in places too wet for other species to grow. In this State, the Bear Meadows in Centre county and the lake regions of Pike, Wayne, and Monroe counties, with their adjoining swamps, give excellent conditions for the natural development of the Red Spruce.

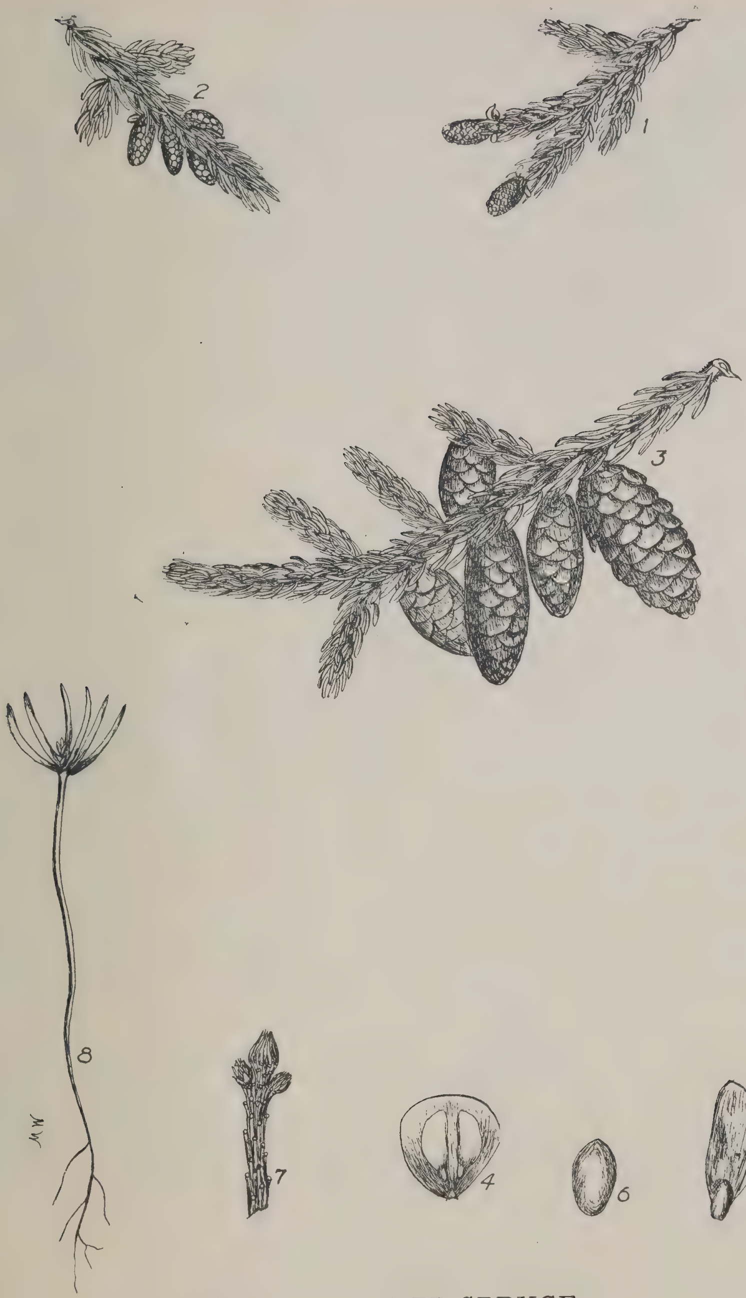

PLATE XX. RED SPRUCE

1. Branch with pistillate flowers, x ½.
2. Branch with staminate flowers, x ½.
3. Branch with needles and cones, x ½.
4. A cone scale with two winged seeds, x ½.
5. A winged seed, natural size.
6. A seed, enlarged.
7. Terminal portion of a twig with buds and without needles, natural size.
8. A seedling, natural size.

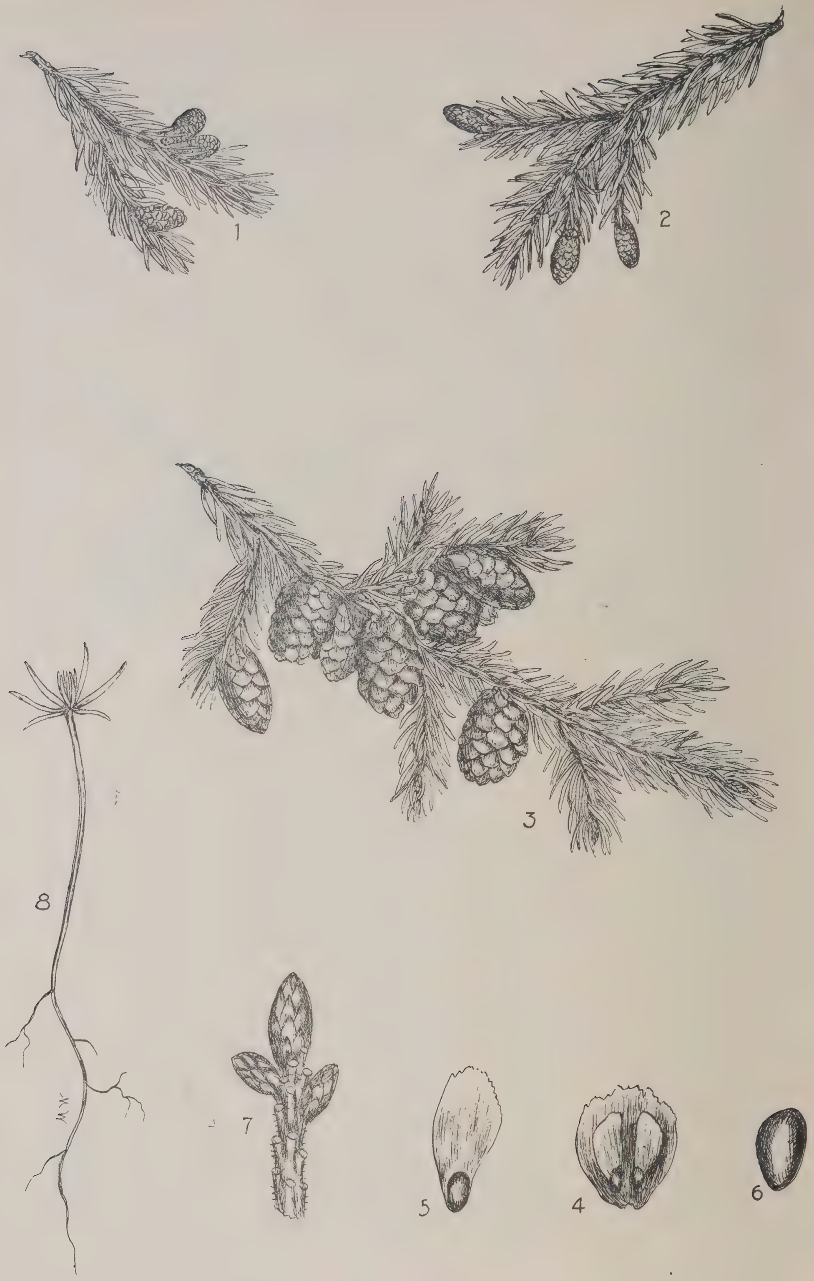

PLATE XXI. BLACK SPRUCE

1. Branch with pistillate flowers, x $\frac{1}{2}$.
2. Branch with staminate flowers, x $\frac{1}{2}$.
3. Branch with needles and cones, x $\frac{1}{2}$.
4. A cone-scale with two winged seeds, x $\frac{1}{2}$.
5. A winged seed, natural size.
6. A seed, enlarged.
7. Terminal portion of a twig with buds and without needles, enlarged.
8. A seedling, natural size.

BLACK SPRUCE

Picea mariana, (Miller) BSP

FORM—A small tree usually attaining a height of 20-30 ft. with a diameter of 1 ft. but may reach a height of 100 ft. with a diameter of 3 ft. Trunk straight, continuous, very tapering, bearing irregular, rather short, horizontal branches, often with ascending tips which give the tree a very narrow, irregular, conic form.

BARK—Up to ⅛ of an inch in thickness and roughened by irregular, thin, close, grayish-brown scales. See Fig. 70.

TWIGS—Rough, stout, brown to yellowish-brown, covered with pale to black hairs.

BUDS—Ovoid, sharp-pointed, ¼-⅓ of an inch long, covered with overlapping, sharp-pointed, reddish-brown scales.

LEAVES—About ¼-¾ of an inch long, 4-sided, bluish-green, rounded at apex, straight or slightly curved, without real leaf-bases, but resting on decurrent projections of bark known as sterigmata.

LEAF-SCARS—See "Leaf-Scars" under Red Spruce.

FLOWERS—Appear about May. Staminate and pistillate flowers occur on same tree but often on different parts of it. Staminate are sub-globose, almost sessile, ⅛ of an inch long, reddish in color. Pistillate are oblong, cylindrical, ⅛ of an inch long.

FRUIT—A cone about 1½ inches long, short-ovoid, short-stalked, maturing at the end of the first season; cone-scales rounded, dull grayish-brown with jagged margin.

WOOD—Non-porous; with resin passages present; light, soft, not strong, pale yellowish-white in color. Weighs 33 lbs. per cubic foot. Used in the manufacture of paper pulp and occasionally in lumber.

DISTINGUISHING CHARACTERISTICS—See "Distinguishing Characteristics" under Red Spruce, page 86.

RANGE—It is a transcontinental tree extending from Labrador to Alaska and south to Pennsylvania and Wisconsin.

DISTRIBUTION IN PENNSYLVANIA—Frequents swamps, rather common along lakes and in swamps of Monroe and Pike counties and in Bear Meadows, Centre and Huntingdon counties. Also reported in Cambria, Carbon, Clinton, Lackawanna, Lycoming, Mifflin, Tioga, Wayne, and Wyoming counties.

HABITAT—The Black Spruce, also known as Swamp Spruce, usually frequents cold, poorly drained swamps throughout its range. It sometimes ascends well drained hillsides, but is usually stunted in such situations. It makes its best growth on moist alluvial soils and is very tolerant of shade.

IMPORTANCE OF THE SPECIES—The Black Spruce is of little commercial importance in Pennsylvania and should be considered for forestry purposes only in extremely swampy locations, where other more valuable trees will not grow. It cannot be recommended for ornamental planting since other species of Spruce far surpass it for this purpose.

NORWAY SPRUCE

Picea Abies, (Linnaeus) Karsten

FORM—A large tree usually attaining a height of 50-80 ft. with a diameter of 2 ft., but may reach a height of 125 ft. with a diameter of 3 ft. Trunk straight, continuous, slightly tapering, and sometimes free from lateral branches for a considerable distance from the base. Crown less acutely pyramidal than that of our native species.

BARK—On old trunks roughened with large, rather thick reddish-brown scales, on younger trunks the scales are thinner and closer. Used in tanneries of Europe, but only slightly charged with tannin.

TWIGS—Slender, rather pendulous, light reddish-brown and roughened by projecting leaf-bases.

BUDS—Ovate to conical, smooth, pointed, covered by overlapping, sharp-pointed, light brown scales.

LEAVES—About ½-1 inch long, sharp-pointed, 4-sided, dark green, without real leaf-stalks, but resting on decurrent projections of bark known as sterigmata.

LEAF-SCARS—See "Leaf-Scars" under Red Spruce.

FLOWERS—Appear about May when pollination takes place. Fertilization takes place in June.

FRUIT—A cone about 4-7 inches long, cylindrical-oblong, pendant, almost sessile, maturing at the end of the first season; cone-scales thin, stiff, rather broad reddish-brown with finely toothed margin.

WOOD—Non-porous; resin passages present; straight-grained, strong, not durable in contact with the soil, medium in hardness, works easily, heartwood yellowish-white with thin white sapwood. Weighs 30 lbs. per cubic foot. Used in the manufacture of paper pulp, general construction, interior finish, basket making and for masts and oars on small vessels.

DISTINGUISHING CHARACTERISTICS—The Norway Spruce, also known as the European Spruce, can readily be distinguished by its large cones, which are from 4-7 inches long, and by the long, pendulous branchlets terminating the lateral branches. The sharp-pointed, bluish-green, 4-sided needles will also aid in distinguishing it from some of the other closely related trees.

RANGE—Its native home is in middle and northern Europe. It forms a very important part of the forest structure of Germany, Switzerland, Austria, and Russia. Planted extensively in the United States for ornamental purposes from Maine south to Washington and west to Kansas.

DISTRIBUTION IN PENNSYLVANIA—It is found throughout the State as an ornamental tree, and planted rather extensively for forestry purposes by the State Department of Forestry. More than 5,000,000 Norway Spruce trees have been planted on the State forests of Pennsylvania.

HABITAT—In Europe it grows in valleys and upon the mountain slopes. It prefers rather rich moist soils, in this respect somewhat resembling the White Pine. It cannot endure very dry, very sterile, or extremely rich vegetable soil. It is rather tolerant of shade and somewhat susceptible to late frosts.

IMPORTANCE OF THE SPECIES—The Norway Spruce is a foreigner in our forest flora, but before long it will be regarded a naturalized member of our forest structure. It will be an extremely valuable addition to our list of forest trees. To the present time it has been planted mostly for ornamental purposes and for wind breaks, but in the future it will also be planted extensively as a forest tree. It grows rapidly and is rather hardy and free from organic enemies and produces valuable wood. A noted European authority on forestry has said: "Spruce is the best paying forest species in the world." Norway Spruce may be planted pure or mixed with other forest trees. It is being grown at a profit for Christmas trees.

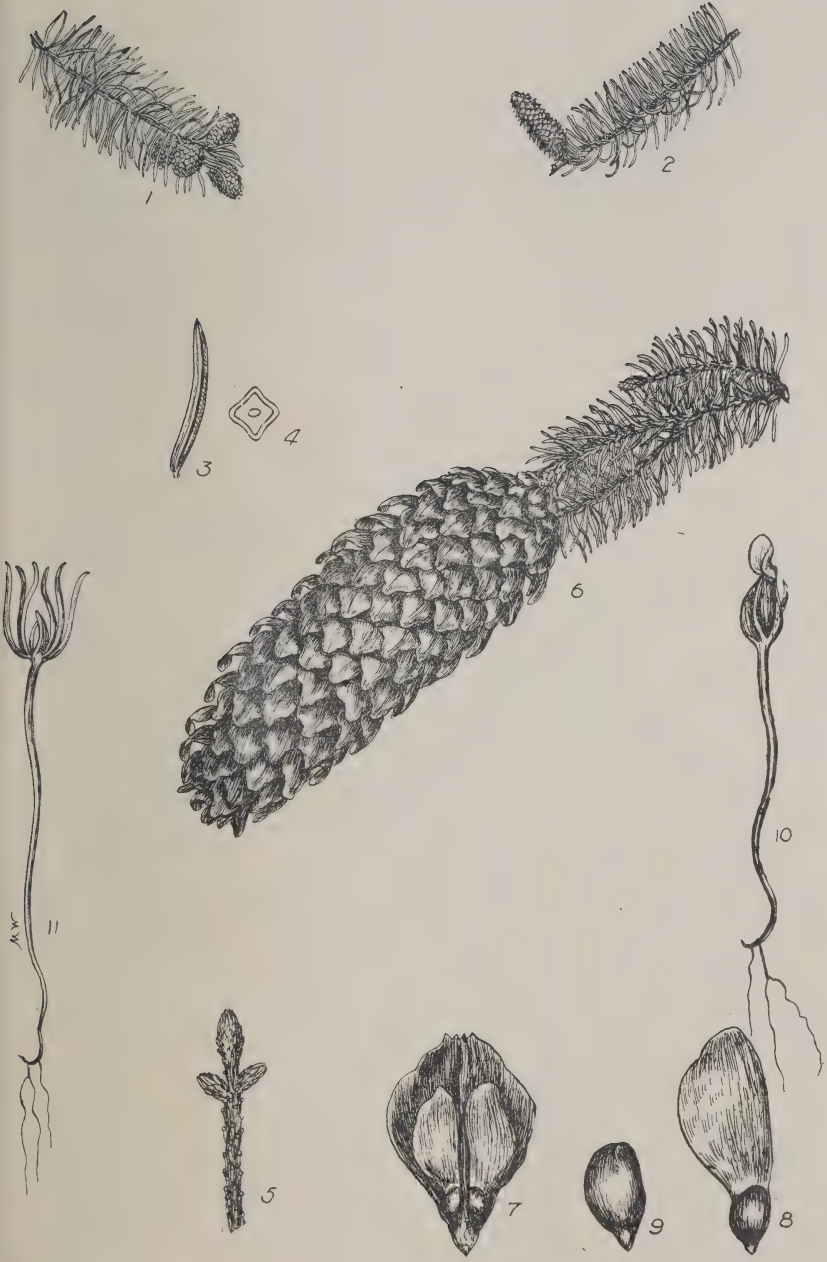

PLATE XXII. NORWAY SPRUCE

1. Branch with staminate flowers, x ½.
2. Branch with pistillate flowers, x ½.
3. A needle, natural size.
4. Cross section of a needle, enlarged.
5. Branch with needles removed showing winter buds, x ¾.
6. Branch with needles and a cone, x ½.
7. A cone scale with two winged seeds, natural size.
8. A winged seed, enlarged.
9. A seed, enlarged.
10. A seedling shedding a seed coat, natural size.
11. A seedling, natural size.

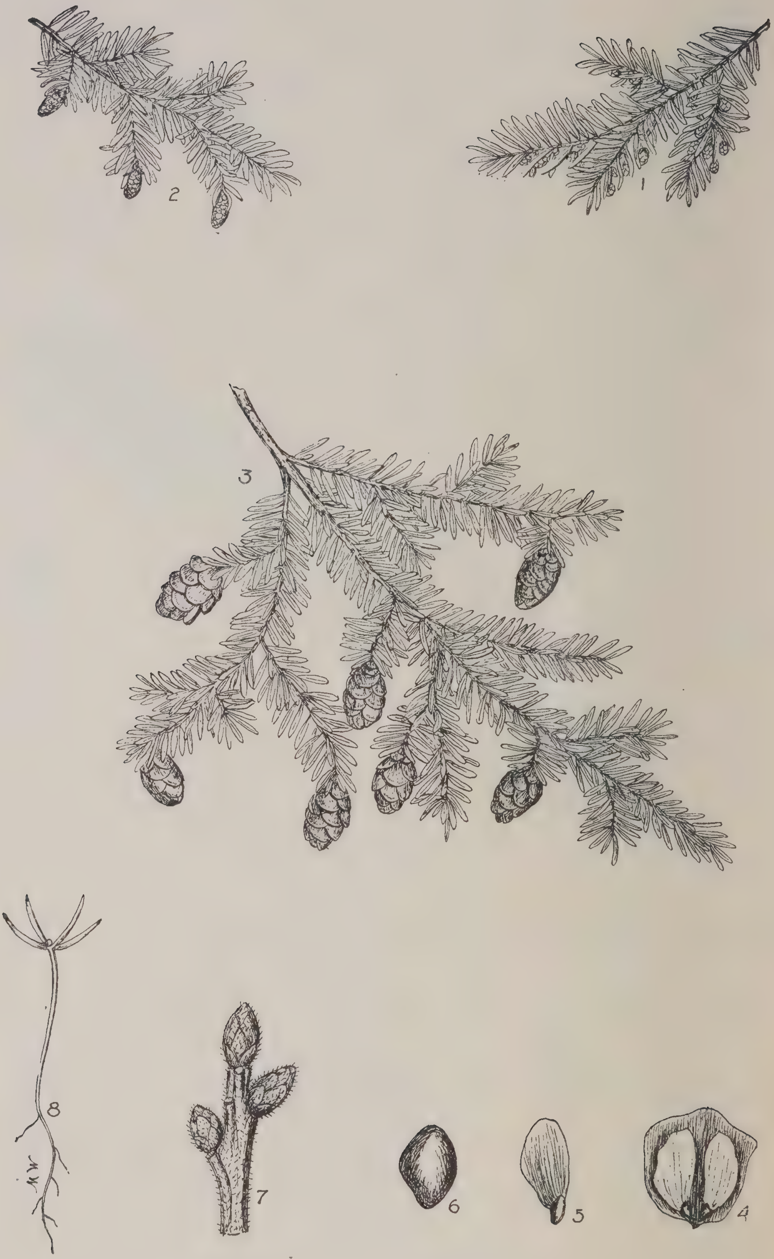

PLATE XXIII. HEMLOCK

1. Branch with needles and staminate flowers, x ½.
2. Branch with needles and pistillate flowers, x ½.
3. Branch with needles and mature cones, x ½.
4. A cone scale with two winged seeds, natural size.
5. A winged seed, natural size.
6. A seed, enlarged.
7. Leafless branch with buds, enlarged.
8. A seedling, natural size.

HEMLOCK

Tsuga canadensis, (Linnaeus) Carriere

GENUS DESCRIPTION—This genius Tsuga comprises 8 species in the world, 4 of which are native to North America and 1 to Pennsylvania. Of the 4 species native to North America, 2 are found in the eastern and 2 in the western part. The 2 eastern species are the Carolina Hemlock (Tsuga caroliniana Engelm.) found only in the mountains from Virginia to Georgia, and the common Hemlock described below. The Hemlocks are trees of the northern hemisphere, found in North America and Asia, but absent in Europe. The eastern Hemlocks in particular, are slow growers and rather difficult to transplant. A well-known student of forestry has said, "Hemlock trees are like the Indians; they will not stand civilization." Recent experiments show that a number of foresters have been transplanting Hemlock successfully.

FORM—A large tree usually attaining a height of 60-80 ft. with a diameter of 2-3 ft., but may reach a height of 100 ft. with a diameter of 4 ft. In the open its crown is dense, conic, and high with limbs extending almost to the ground. In dense stands it has a bole clean from lateral branches for a considerable distance from the ground and with little taper.

BARK—Grayish-brown to reddish-brown, rich in tannin, becoming 4/5 of an inch thick on old trunks and roughened by long fissures separating rather broad ridges which are covered with close scales. Inner bark is cinnamon-red. See Fig 72.

TWIGS—Slender, rough on account of decurrent projections of bark upon which the leaves rest, at first somewhat hairy and yellowish-brown, later smooth grayish-brown tinged with purple.

BUDS—Alternate, ovate, 1/16 of an inch long, blunt--pointed, reddish-brown, not glossy.

LEAVES—Linear, flat, about ½ of an inch long, rounded or notched at apex, dark green and shining above, pale green and dull below with a white line on each side of midrib. The leaves persist for about 3 years and are jointed to short, persistent, woody stalks. They are spirally arranged around the twig but appear two-ranked.

LEAF-SCARS—Small, round, raised on decurrent projections of bark.

FLOWERS—Appear about April or May. Staminate and pistillate flowers are separate, but usually borne on the same branch. Staminate are small, globose, yellow, about ¼ of an inch long. Pistillate are oblong and pale green.

FRUIT—A small, short-stalked cone maturing at the end of the first season, about ¾ of an inch long, usually persisting during first winter.

WOOD—Non-porous; without resin passages; light, hard, not strong, brittle, coarse-grained, not durable, liable to splinter, difficult to work, light brown with lighter sapwood. Weighs 26 lbs. per cubic foot. Used for construction, coarse lumber, and especially for frame work and weather-boarding of buildings, paper pulp, and laths.

DISTINGUISHING CHARACTERISTICS—The Hemlock, also known as Hemlock Spruce and Spruce Pine, can be distinguished by its flat linear needles with two longitudinal white streaks on the lower surface; the needles are jointed to short persistent woody stalks known as sterigmata and appear two-ranked, but in addition to the two conspicuous lateral rows there is a rather inconspicuous row of small needles on top of the twig extending in the same direction as the twig. The lateral twigs occur rather irregularly along the main branches and diverge from the latter at an angle of usually less than 75 degrees. The cones are about ¾ of an inch long, and often persist through one winter. The inner bark is cinnamon-red. The early lumbermen recognized two varieties of Hemlock, namely, White Hemlock and Red Hemlock.

RANGE—Nova Scotia south to Pennsylvania and along the mountains to Alabama, and west to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Rather commonly distributed in moist situations throughout the mountainous regions of the State. Most common in the central and northern parts. Scattered in local groups in narrow, cool ravines, and on rocky slopes in the southeastern and southwestern parts.

HABITAT—Usually found in moist locations, such as northern slopes of rocky ridges, banks of streams, ponds and lakes, swamps, river gorges, and mountain slopes. It prefers a dense forest structure since it is shade loving and not very wind-firm.

IMPORTANCE OF THE SPECIES—The Hemlock yields not only lumber but also bark rich in tannic acid and a volatile oil to which a medicinal value is attached. The ordinary wood which it produces coupled with its rather slow growth and the difficulty with which it is established by planting will tend to decrease its prevalence in our forest structure, especially since more valuable and more rapid-growing species like Pine and Spruce will thrive on the same area. Wherever it can be regenerated naturally without sacrificing more valuable species it should be retained in the forest structure. It is one of the most attractive, if not the most attractive, of our coniferous evergreen trees.

BALSAM FIR

Abies Balsamea, (Linnaeus) Miller

GENUS DESCRIPTION—The Firs comprise about 25 species, of which number 10 are native to North America and 1 to Pennsylvania. They are usually found in cold and temperate regions. Eight species are found in western North America, while only 2 species are native east of the foot hills of the Rocky Mountains. One of these is native to Pennsylvania. The other eastern species not native to Pennsylvania, Abies Fraseri (Pursh.) Poir, is found only in the Appalachian Mountains from Virginia to North Carolina and Tennessee.

FORM—A medium-sized tree attaining a height of 30-50 ft., but may reach a height of 100 ft. with a diameter of 3 ft. Usually a low spreading shrub in high altitudes and high latitudes. Crown slender, symmetrical when young, and sharp-pointed, deeper and often broader in older specimens.

BARK—On old trees reddish-brown and somewhat roughened by irregular scales. On young trees smooth, thin, close, grayish-brown, and marked by projecting resin blisters. See Fig. 69.

TWIGS—Slender, at first hairy and yellowish-green, later smooth and grayish-brown, usually arranged opposite one another.

BUDS—Clustered at end of terminal twigs, ovate to spherical, about 1/6 of an inch long, covered with very glossy, varnished, orange-green scales.

LEAVES—Apparently 2-ranked as in the Hemlock, linear, flattened, ¾ of an inch long, usually blunt at apex, stalkless, dark green and shining above, pale with light dots below, very fragrant upon drying.

FLOWERS—Appear about May or June. Staminate and pistillate flowers occur separate, but usually found on different parts of same branch. Staminate are cylindrical, yellow, ¼ of an inch long. Pistillate are oblong-cylindrical, purple, 1 inch long.

FRUIT—An erect, oblong-cylindrical, dark purple cone, 2-4 inches long, with broad round deciduous scales which fall off and leave the bare central axis. Cones mature at the end of first season. Seeds about ¼ of an inch long, winged, and borne on cone-scales.

WOOD—Non-porous; without resin passages; with no distinct heartwood, light, soft, pale brown, not strong nor durable. Weighs 24 lbs. per cubic foot. Used with Spruce for paper pulp, crates, packing boxes, and occasionally for lumber.

DISTINGUISHING CHARACTERISTICS—The Balsam Fir, also known as Fir, Balsam, and Blister Pine, is distinguished from the other native conifers of Pennsylvania by its smooth grayish-brown bark covered with projecting blisters, its oblong-cylindrical erect cones with deciduous scales, and by its rather flattened, apparently 2-ranked leaves which are stalkless and leave a circular flat scar upon falling. The leaves of the Balsam Fir somewhat resemble those of the Hemlock, but they are not jointed to a woody stalk while those of the latter species are jointed to short persistent stalks known as sterigmata.

RANGE—Labrador west to Alberta, south to Pennsylvania and Minnesota and along the mountains to Virginia.

DISTRIBUTION IN PENNSYLVANIA—Confined almost entirely to the swamps and lake regions in Centre, Clinton, McKean, Pike, Monroe, Lycoming, Tioga, Warren, Wayne, Susquehanna and Sullivan counties. It is also reported from a few other local outposts.

HABITAT—Usually inhabits swamps or their borders. In the north found commonly in low swampy bogs but in the south usually found on the mountain tops and slopes. Generally occurs in mixture but may occur locally in almost pure stands. Spruce and Hemlock are its common associates.

IMPORTANCE OF THE SPECIES—Balsam Fir is of little commercial importance in Pennsylvania on account of its limited distribution and the small size which it attains. It is difficult to regenerate artificially since the seeds have a low germinating percentage, and the subsequent establishment is also difficult. This species should be regenerated naturally upon such areas where other more valuable species will not grow. The Balsam Fir is commonly used as a Christmas tree and it is possible that in the future it may pay to raise it for this purpose. A plantation of Balsam Fir was established in Pike county in 1903. The trees are now 25 feet high.

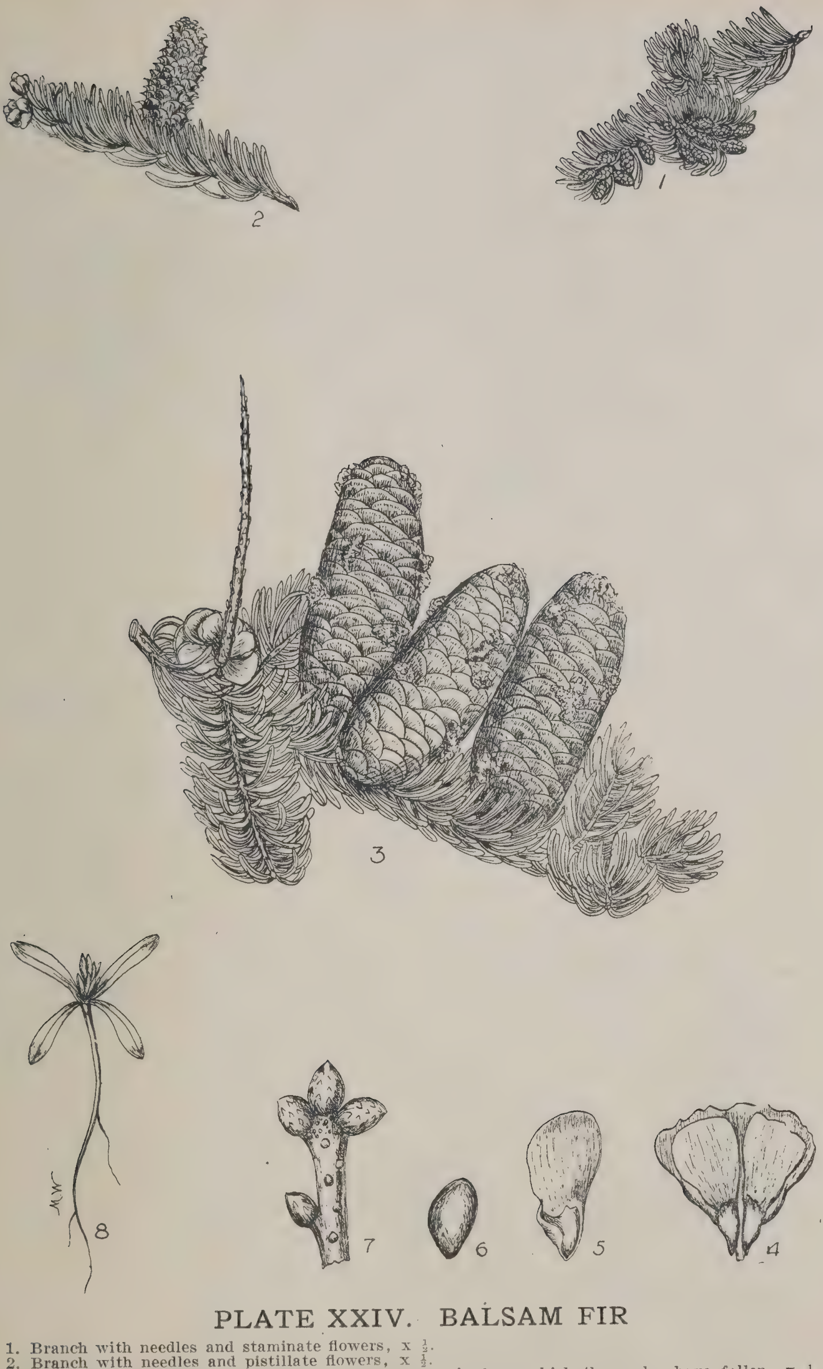

PLATE XXIV. BALSAM FIR

1. Branch with needles and staminate flowers, x ½.
2. Branch with needles and pistillate flowers, x ½.
3. Branch with needles, three cones and one cone axis from which the scales have fallen, x ½.
4. A cone scale with two winged seeds, natural size.
5. A winged seed, slightly enlarged.
6. A seed, enlarged.
7. Leafless branch with buds, slightly enlarged.
8. A seedling, x ½.

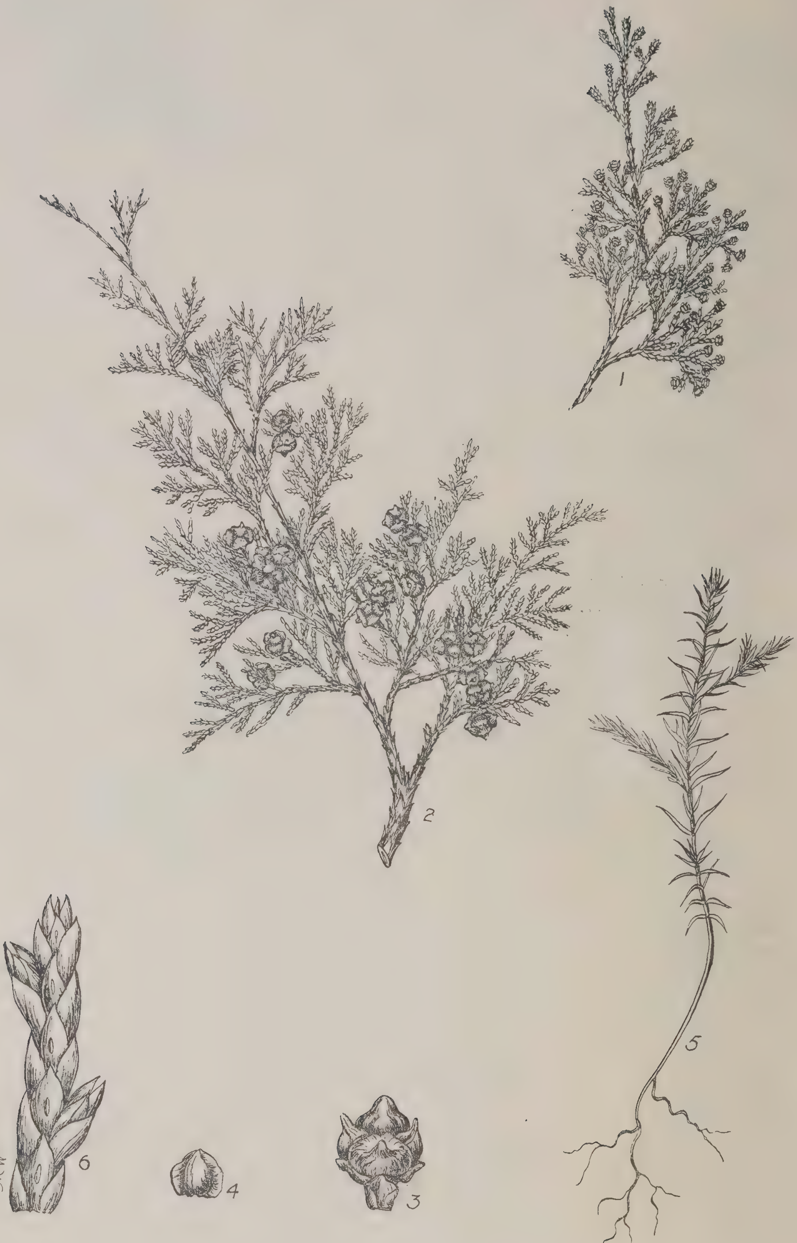

PLATE XXV. WHITE CEDAR

1. A flowering branch, x ½.
2. A branch with needles and fruit, x ½.
3. **A cone, slightly enlarged.**
4. A winged seed, slightly enlarged.
5. A seedling, natural size.
6. Portion of branch, enlarged.

WHITE CEDAR

Chamaecyparis thyoides, (Linnaeus) BSP

GENUS DESCRIPTION—The genus chamaecyparis comprises about 6 species in the world, of which number 3 are native to North America. Of the 3 species native to North America 2 are found in the western part, while only 1 is found in the eastern part. The latter was at one time native to a small portion of Pennsylvania. The Cedars are not very well known as forest trees, but are planted extensively in this country and abroad for ornamental purposes. The lumberman is just beginning to appreciate the value of the wood which is obtained from the western species.

FORM—A small tree usually attaining a height of 30-50 ft. with a diameter of 1-2 ft., but may reach a height of 90 ft. with a diameter of 4 ft. Trunk straight, continuous, tapering, and bears slender horizontally spreading branches which form a narrow, pointed, conical crown.

BARK—Rather thin, reddish-brown, somewhat furrowed, peels off into long, fibrous, film-like scales.

TWIGS—Rather slender, somewhat flattened, at first bluish-green, later after the leaves have fallen they become roundish and reddish-brown. The terminal twigs are often arranged in fan-like clusters.

BUDS—Very small and inconspicuous, usually covered by the closely overlapping scale-like leaves.

LEAVES—Small, ovate, sharp-pointed, bluish-green, closely overlapping, scale-like, 4-ranked but presenting a compressed appearance. Often spreading and awl-shaped on vigorous shoots. A conspicuous but rather small glandular dot is often found on the back.

LEAF-SCARS—Not present because leaves persist for 4 or more years; then die and dry up upon the branches.

FLOWERS—Appear in March or April. Staminate flowers are oblong, about ⅛ of an inch long, with 10-12 stamens on shield-shaped filaments. Pistillate flowers are globular, about 1/10 of an inch in diameter, with about six shield-shaped scales each usually bearing 2 ovules.

FRUIT—A small globose cone which is rather common but inconspicuous, about ¼ of an inch in diameter and maturing at the end of the first season. Scales of cone shield-shaped and joined to axis of cone by stalk. Outer face of scale is marked by a slight projection. Each fertile scale bears 1 or 2 fertile winged seeds.

WOOD—Non-porous; light, soft, not strong, very durable, slightly fragrant, light brown tinged with red; sapwood pale. Weighs 21 lbs. per cubic foot. Used in cooperage and boat building, for fence posts, railroad ties, shingles, and woodenware.

DISTINGUISHING CHARACTERISTICS—The White Cedar, also known as Cedar and Coast White Cedar, can be distinguished by its characteristic globose fruit with shield-shaped scales which are fastened to the main axis by means of short stalks. It somewhat resembles the Arbor Vitae but the former has less flattened and less distinctly fan-shaped twigs. The twigs of the White Cedar are not so stout as those of the Arbor Vitae. The former also has bluish-green leaves while the latter has yellowish-green. It can be distinguished from the Red Cedar and the Common Juniper by its more prominent glandular dots on the leaves and its round twigs; the twigs of the latter species are 3 to 4-sided. It also lacks the awl-shaped leaves found on the Common Juniper and usually present on the Red Cedar.

RANGE—Cape Breton Island southward along coast region to Florida and Mississippi.

DISTRIBUTION IN PENNSYLVANIA—A Costal Plains species, which occurred originally in a few swamps in the extreme southeastern part of the State, but is now entirely extinct in Pennsylvania. The two stations, where it was found at an early date, are at Tinicum Swamp, in Delaware county, and the swamps in the vicinity of Bristol, Bucks county. Found as an ornamental tree in every part of the State.

HABITAT—Prefers swamps and marshes but will grow in dry locations. Occupies many swamps to the exclusion of other tree species. In the south it is often found in the swamps with the Bald Cypress and in the north with Arbor Vitae, Fir, and Spruce.

IMPORTANCE OF THE SPECIES—The White Cedar is so limited in its distribution in Pennsylvania and the wood of so little commercial importance that it cannot be recommended for forestry purposes. It may be recommended for very swampy locations where other more valuable trees will not grow, and deserves to be planted extensively for ornamental purposes since it is one of the most beautiful coniferous trees of eastern North America on account of its attractive form and beautiful foliage. More than a dozen varieties of it are known.

ARBOR VITAE

Thuja occidentalis, Linnaeus

GENUS DESCRIPTION—The genus Thuja comprises 4 known species in the world, of which number 2 are found in North America. One of the 2 species native to North America is found in the eastern part, and the other in the western part. The western species attains a large size, while the one found in the East usually remains a small tree. They are best known as ornamental trees but furnish some lumber, which is very valuable on account of its great durability. The bark also yields tanning material and the twigs and leaves contain a volatile oil which possesses stimulating properties.

FORM—A medium-sized tree usually attaining a height of 20-50 ft. with a diameter of 1-2 ft. but may reach a height of 75 ft. with a diameter of 3-4 ft.

TRUNK—Tapering, furrowed, buttressed and often divided. Crown dense, conical, very high, and often covered with foliage almost to the base.

BARK—Grayish to reddish-brown, thin, furrowed, separating into long rather thin, fibrous and often persistent strips.

TWIGS—Yellowish-green, evidently flattened, somewhat 4-sided, completely covered by closely adhering leaves, zigzag or arranged in fan-shaped clusters.

BUDS—Leaf-buds not scaly, covered by closely adhering scale-like leaves.

LEAVES—Opposite, scale-like, closely overlapping, aromatic when crushed, with very conspicuous glandular spots on the thrifty shoots, ⅛ of an inch long, of two kinds in alternating pairs. Those on the side of the twigs keeled; those on the face of the twigs flat.

FLOWERS—Appear about April or May. Staminate and pistillate flowers usually occur on different twigs. Staminate are roundish, inconspicuous and yellowish. Pistillate are small, ovoid, purplish, with 4-6 pairs of thin oval scales.

FRUIT—An oblong cone with 6-12 obtuse scales, ⅓-½ of an inch long, reddish-brown, matures in one season. Seeds oblong, winged, about ⅛ of an inch long.

WOOD—Non-porous; resin passages absent; light, soft, durable, fragrant; sapwood almost white, heartwood yellowish-brown. Weighs 20 lbs. per cubic foot. Used for fence posts, rails, shingles, spools, and railroad ties.

DISTINGUISHING CHARACTERISTICS—The Arbor Vitae, also known as White Cedar and Cedar, may be distinguished at any season of the year by its scale-like and closely overlapping leaves from all the other trees native to the State of Pennsylvania except the White Cedar. It can be distinguished from the latter, which also has scale-like leaves, by its more flattened and larger twigs, which are also more fan-shaped. The fruit of the Arbor Vitae is oblong with thin oblong scales, while that of the White Cedar is spherical with thick shield-shaped scales.

RANGE—Southern Labrador west to Manitoba and Minnesota, and south along the mountains to North Carolina and eastern Tennessee.

DISTRIBUTION IN PENNSYLVANIA—The Arbor Vitae is found to the north and south of Pennsylvania, but so far no authentic records are available which show that it is native to this State. It is, however, found very commonly throughout the entire State as an ornamental tree and sometimes as a hedge.

HABITAT—Usually found in low swampy situations on the borders of ponds, streams, and lakes, but occasionally ascends to drier ground In the north it is often found in the sphagnum bogs with Spruce and Fir, while in the south it is usually found on the mountain slopes and tops with the Spruce and other coniferous species.

IMPORTANCE OF THE SPECIES—The Arbor Vitae is one of our most valuable trees for ornamental purposes. It is common throughout the State as an ornamental tree and occasionally planted for hedges. As a timber tree, however, it is surpassed by many other native trees and should be planted for forestry purposes only in such habitats where other more valuable trees will not grow.

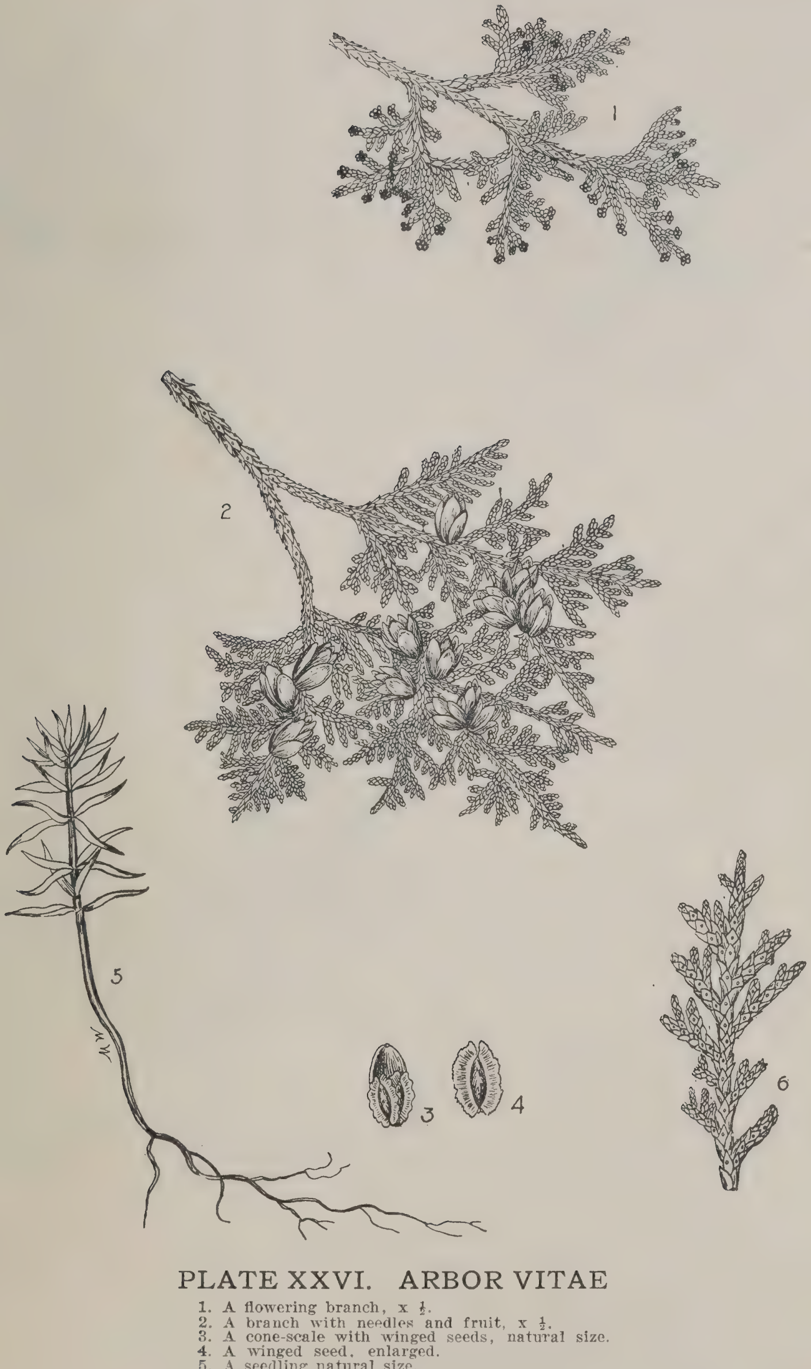

PLATE XXVI. ARBOR VITAE

1. A flowering branch, x ½.
2. A branch with needles and fruit, x ½.
3. A cone-scale with winged seeds, natural size.
4. A winged seed, enlarged.
5. A seedling natural size.
6. Portion of branch, natural size.

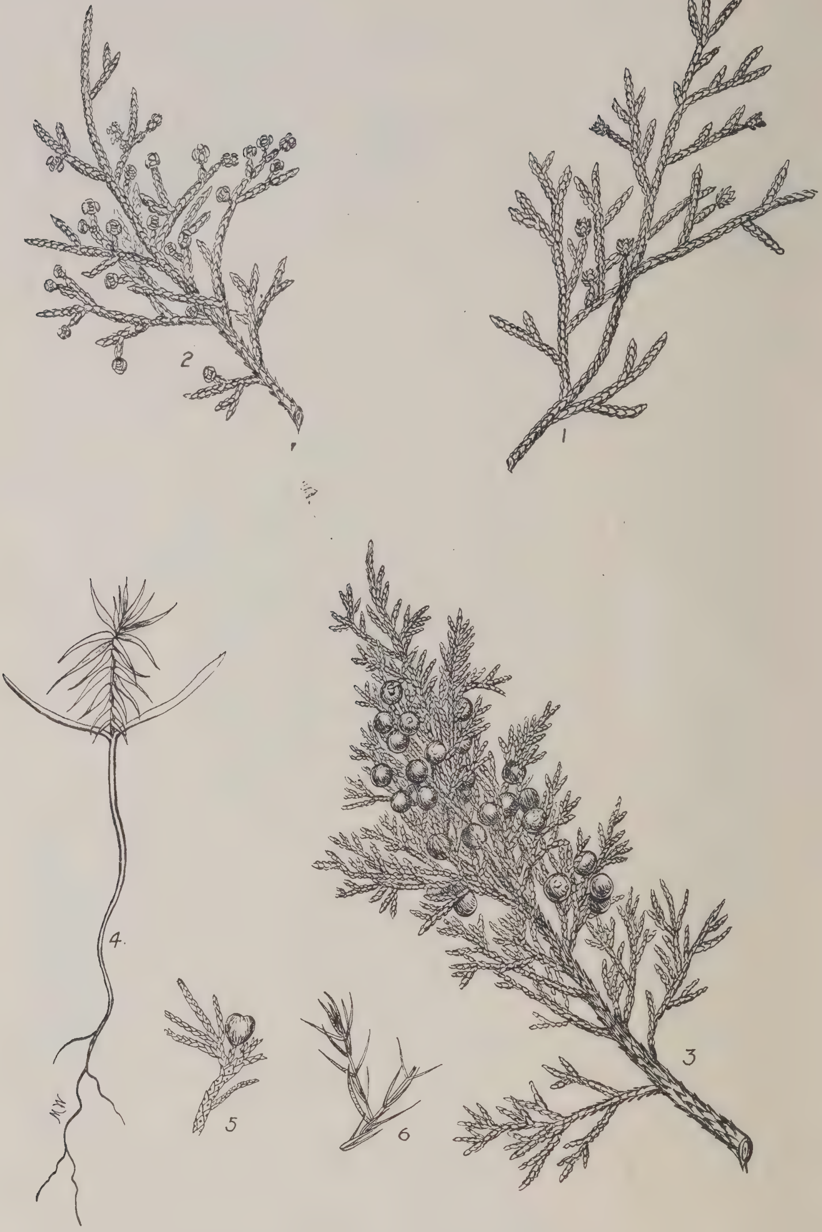

PLATE XXVII. RED CEDAR

1. A branch with pistillate flowers, x ½.
2. A branch with staminate flowers, x ½.
3. A branch with needles and fruit, x ½.
4. A seedling, natural size.
5. A branch with scale-like needles and a single berry-like fruit, natural size.
6. A branch with awl-shaped needles, x ½.

RED CEDAR

Juniperus virginiana, Linnaeus

GENUS DESCRIPTION—The genus Juniperus comprises about 40 species of trees and shrubs in the world, of which number 16 species are native to North America and 2 to Pennsylvania. The Junipers are usually medium-sized trees or occasionally shrubs. This is possibly the most widely distributed genus of trees in North America, since there is hardly a state in the United States in which some one or a few of them do not grow. They have little value as timber trees since only 1 species reaches a size large enough to produce timber. The fruit of the Junipers, usually called berries, is the most distinctive character of the trees. These berries are in reality cones, but have the appearance of a berry. In addition to the species described here, the Common Juniper (Juniperus communis, Linnaeus) is also native to this State. It is usually a shrub, found locally in the eastern and northern parts of the State and extends as far south as Cornwall, in Lebanon county.

FORM—An average-sized tree usually attaining a height of 25-40 ft. with a diameter of 1-2 ft., but may reach a maximum height in the south of 120 ft. with a diameter of 3-4 feet. Crown usually deep, dense, narrow, and conic, but occasionally in old specimens broad, spreading, and round-topped.

BARK—Rather thin, often grooved, reddish-brown, peeling off into rather long, narrow, stringy, film-like strips. See Fig. 71

TWIGS—Slender, usually four-sided and green as long as leaves persist, but after leaves have fallen are round and reddish-brown.

BUDS—Inconspicuous, because they are small in size and covered with leaves.

LEAVES—Two kinds are recognized, scale-shaped and awl-shaped. Scale-shaped form is typical. They are about 1/16 of an inch long, ovate, closely appressed, acute to round at apex, dark bluish-green, sometime glandular on back, and four-ranked giving the twig an angular appearance. The awl-shaped, which usually occur on young trees or on vigorous shoots, are narrow, sharp-pointed, spreading, scattered, not overlapping, opposite, in 2s or in 3s.

FLOWERS—Appear about April or May. Staminate and pistillate flowers usually occur on different trees but occasionally are found on the same tree. Staminate are short-stalked, yellow, consisting of about 10 stamens, and produced in great numbers. Pistillate are small, with about 6 spreading, sharp-pointed, bluish scales.

FRUIT—A dark blue berry about ¼ of an inch in diameter, often covered with a white bloom and maturing at the end of the first or second season. Flesh sweet and covering 1-2 seeds. Fruit often persists during the winter and furnishes food for birds.

WOOD—Non-porous; without resin passages; with distinct red heartwood and nearly white sapwood; light, soft, fragrant, weak, durable in contact with the soil, easily worked. Weighs 31 lbs. per cubic foot. Used largely for fence posts, lead pencils, moth-proof chests and closets, interior finish, furniture, rustic work, pails, and tubs.

DISTINGUISHING CHARACTERISTICS—The Red Cedar, also known as Red Juniper, Cedar, and Savin, can readily be distinguished from all the other conifers of Pennsylvania except the Common or Dwarf Juniper by its berry-like fruit, if present. The Common Juniper does not have the scale-like leaves of the Red Cedar, and the awl-shaped leaves of the Red Cedar are generally darker on the upper surface and not regularly in 3s. The awl-shaped leaves of the Common Juniper occur regularly in 3s, are larger, sharper-pointed than those of the Red Cedar, white on the upper surface, not decurrent along the twig, and diverge almost at right angles. The Red Cedar also reaches a larger size and is usually more erect, but bears less conspicuous winter buds. See "Distinguishing Characteristics" under White Cedar.

RANGE—Nova Scotia west to Ontario and South Dakota, south to Florida and Texas. The Common Juniper has the widest range of any tree in the northern hemisphere.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State, but rare in northern and western part. Usually solitary and scattered in abandoned fields and along fences. Very common on the shale hills, abandoned fields, and pasture lands of Adams, Bucks, York, Lancaster, Montgomery, and Franklin counties. Abundant on the ledges and cliffs along the west bank of the Delaware River in Monroe and Pike counties. Common on shale soils.

HABITAT—It will accept almost any location from a swamp to a poor rocky cliff but reaches its best development in the swamps and alluvial soils of the southern states. Limestone soil is favorable to its growth. Abundant light is necessary for optimum development but it will tolerate shade for many years.

IMPORTANCE OF THE SPECIES—The Red Cedar produces a valuable wood but grows very slowly. Other more valuable and more rapid growing trees will thrive upon the same areas and bring much earlier returns. It is also subject to the attack of fungous diseases, especially when young. Many ornamental varieties and forms have been developed which are highly prized for landscape work. It is used rather extensively in certain localities of the State as a Christmas tree.

THE WILLOW FAMILY—SALICACEAE

The Willow family comprises about 200 species belonging to two genera, the well-known Willows and the Aspens or Poplars. The members of this family comprise both trees and shrubs found chiefly in the north temperate and arctic zones. A few shrubby species extend far into the arctic regions. They usually prefer moist habitats but may also be found on drier locations. One is very apt to associate the Willows with wet habitats.

The flowers appear in early spring, usually before the leaves. The staminate (male) and pistillate (female) flowers are produced on different trees. A tree bearing staminate flowers does not bear pistillate. As a consequence one will find fruit only upon pistillate trees. The pistillate flowers are fertilized by insects, usually bees, which carry the pollen from the staminate flowers. The fruit consists of capsules which split into 2-4 parts and are arranged in drooping tassel-like clusters. The fruit matures in late spring at about the same time that the leaves reach their full-size. The seeds are small and surrounded by a dense covering of long white hairs which aid considerably in their dispersal. The seeds must germinate soon after they mature or they will lose the power of germination. The bark is usually rather bitter.

Representatives of both Willows and Poplars are noted for their remarkable ability to grow both from root and shoot cuttings. One can cut a small twig from a tree, put it into moist ground, and feel assured that it will grow. They also sprout very freely from stumps irrespective of the age of the stump. The following key will distinguish the two genera belonging to this family.

KEY TO THE GENERA

			Page
1.	Buds with one bud-scale; bracts of the catkins entire; stamens fewer than 10, usually 2,	Salix	94
1.	Buds with more than one bud-scale; bracts of the catkins fringed or lobed; stamens usually 10 or more,	Populus	100

THE WILLOWS—SALIX (Tourn.) L.

The genus Salix comprises about 175 species of which number about 100 species are native to North America and about 15 to Pennsylvania. The members of this family are met as trees and shrubs. Most of our native species are small trees or shrubs. Those which attain tree-size are usually found near buildings and have been introduced.

The Willows produce wood which is light, soft, not durable, and weak. It is of little commercial importance. The value of the Willows lies in the shoots or rods which are used in the manufacture of baskets and furniture. Some reach a large enough size to be used for saw lumber but the trunks are usually of a poor shape and also begin early to decay in the center. They are valuable to bind the border of streams by means of their interlacing roots and thus prevent erosion. They may also be used to prevent the movement of shifting sands.

Few trees possess such a tenacious vitality as the Willows. They live a long time after they appear to be dying and repair broken parts very readily and often replace them with new growth. They reproduce freely by means of sprouts, cuttings, and seeds. On very wet situations, like islands or the borders of streams, they often form dense thickets to the exclusion of almost all other growths.

The Willows as a group are easily recognized even by a layman. They have a characteristic external appearance which one can soon learn to appreciate. It is, however, difficult to distinguish the different Willows from each other. They sport and hybridize freely. Very often one leaves a Willow in despair because of the fact that it was impossible to identify it. Only 4 of the 15 or 20 Willows found in Pennsylvania are described below because many of them are mere shrugs and others have been introduced from the eastern hemisphere. The Weeping Willow (Salix babylonica L.) (Fig. 56) is very common in cultivation and in some localities it has escaped cultivation. It can readily be distinguished by its drooping branches. The Crack Willow (Salix Fragilis L.) is a native of Europe. It is common along our streams where it reaches a large tree-size. The lateral branches are very brittle and after a windstorm the ground around the tree is usually covered with branchlets which have cracked off, whence the name Crack Willow.

KEY TO THE WILLOWS*

			Page
1.	Leaves persistently hairy at least beneath,	S. rostrata	99
1.	Leaves smooth or nearly so when mature,	2	
2.	Large tree; leaves narrowly lanceolate,	S. nigra	96
2.	Shrub or small tree rarely 20 feet tall; leaves broadly lanceolate,	3	
3.	Capsules pubescent; petioles and stipules not glandular; buds large,	S. discolor	98
3.	Capsules glabrous; petioles and stipules glandular; buds small,	S. lucida	97

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*It is not intended that this key will enable one to distinguish all the species of Willow found in Pennsylvania. It simply aims to point out the distinguishing characteristics of the four species which are described here. Other species may be distinguished by the use of Porter's Flora of Pennsylvania.

BLACK WILLOW

Salix nigra, Marshall

FORM—Largest of our native tree-willows, usually 25-30 ft. high with a diameter of 10-20 inches, but may reach a height of 60-80 ft., with a diameter of 2-3 feet. Trunks usually crooked, often inclined and occurring in small groups. Crown wide, open and round-topped.

BARK—Thick, rough, deeply furrowed, blackish-brown, with wide ridges covered with thick scales. Ridges of bark often connected by narrow, transverse or diagonal ridges.

TWIGS—Slender, smooth, brittle, drooping, bright reddish-brown to orange colored.

BUDS—Alternate, small, about ⅛ of an inch long, sharp-pointed, reddish-brown, covered by a single scale.

LEAVES—Alternate, simple, narrowly-lanceolate, very long-pointed, tapering or slightly rounded at base, finely serrate on margin, usually smooth and dark green above, pale green below.

LEAF-SCARS—Alternate, narrow, with 3 bundle-scars in a lunate line. Terminal scar often larger than lateral ones. Stipule-scars large and prominent.

FLOWERS—Appear in March or April before the leaves. Staminate and pistillate flowers occur on separate trees, and both are borne in drooping aments or catkins from 1-3 inches long.

FRUIT—A reddish-brown, smooth, ovate capsule which splits open and liberates many small seeds. Seeds covered with a dense tuft of fine long hairs.

WOOD—Diffuse-porous; with very inconspicuous medullary rays; reddish-brown, soft, weak, firm, close-grained, not durable. Weighs about 28 lbs. per cubic foot. Used mainly for fuel and charcoal.

DISTINGUISHING CHARACTERISTICS—The Black Willow is the largest of our native Willows. The rough, thick-scaled, blackish-brown bark is characteristic. The narrowly-lanceolate and short-petioled leaves which are always smooth or nearly so are also distinctive. The trunks often occur in small groups. The slender drooping branches are easily broken off at their ends.

RANGE—New Brunswick to Florida, west to Dakota, Kansas, southern Arizona and central California.

DISTRIBUTION IN PENNSYLVANIA—Throughout the State. Most common in eastern and southern parts.

HABITAT—Prefers moist or wet situations like banks of streams and lakes. Requires plenty of light. Occasionally found on moist, gravelly and sandy soil.

IMPORTANCE OF THE SPECIES—The Black Willow is the largest tree-willow native to our flora and is very conspicuous in its appearance. It is of no present or prospective value except as a soil conserver and to a limited extent as a producer of fuel wood and charcoal. Other more valuable and more attractive trees should be grown in place of it.

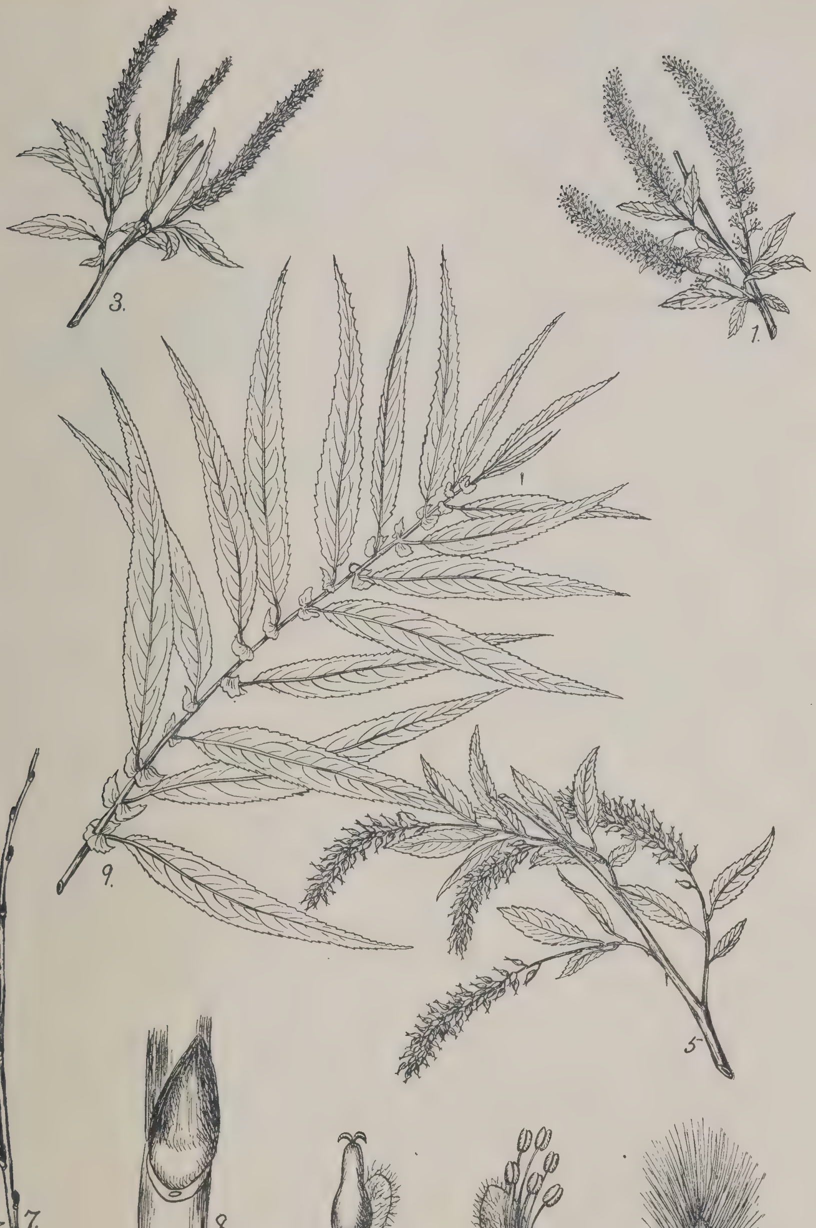

PLATE XXVIII. BLACK WILLOW

1. A staminate flowering branch, x ½.
2. A staminate flower, enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, enlarged.
5. A fruiting branch, x ½.
6. A seed with hairs, enlarged.
7. A winter twig, x ½.
8. Section of a winter twig with bud and leaf-scar, enlarged.
9. A leafy branch, x ½.

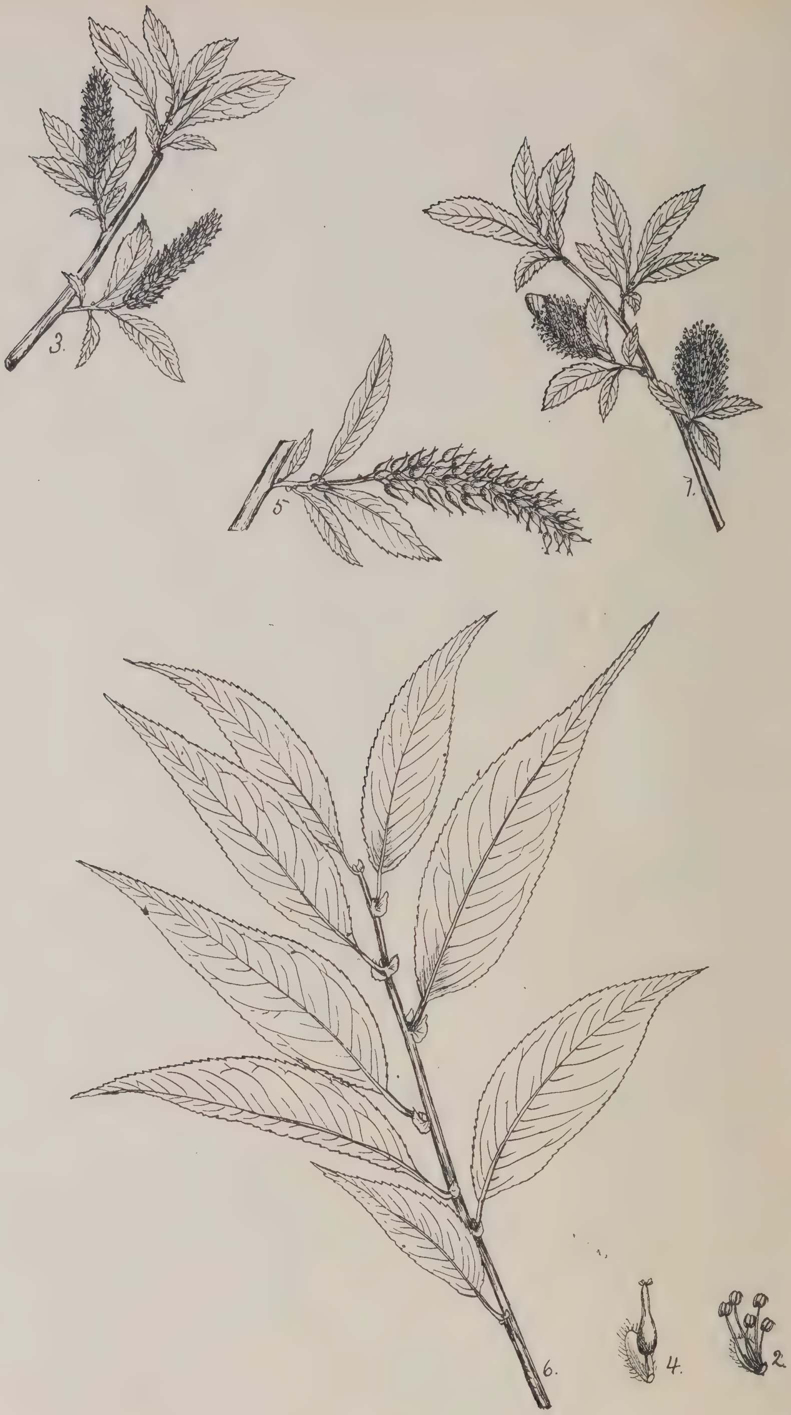

PLATE XXIX. SHINING WILLOW

1. A staminate flowering branch, x ½.
2. A staminate flower, slightly enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, slightly enlarged.
5. Section of a fruiting branch, x ½.
6. A branch with mature leaves, x ½.

SHINING WILLOW

Salix lucida, Muhlenburg

FORM—A shrub or small tree sometimes reaching a height of 25 ft. with a diameter of 8 inches. Trunk short, bearing rather ascending branches which form a rather symmetrical and broad crown.

BARK—Smooth, thin, bitter, brown to reddish-brown.

TWIGS—Shining, yellowish-brown, later dark brown.

BUDS—Alternate, smooth, ovate, pointed, about ¼ of an inch long, covered by a single yellowish brown scale.

LEAVES—Alternate, simple, broadly lanceolate to ovate, long-pointed at apex, tapering or rounded at base, finely toothed on margin, smooth and shining above, paler below.

LEAF-SCARS—Alternate, somewhat raised, lunate, with 3 conspicuous bundle-scars.

FLOWERS—Appear in catkins about April before the leaves have unfolded. Staminate and pistillate flowers occur on separate trees. The staminate have five stamens, and are arranged in dense flowered catkins about 1—1½ inches long. The pistillate are arranged in slender catkins from 1½-2 inches long.

FRUIT—A narrowly-ovoid, smooth, dull, evidently-stalked, straw-colored to pale brown or greenish capsule which is evidently-rounded at the base.

WOOD—Same as that of other Willows. See description under Black Willow, page 96.

DISTINGUISHING CHARACTERISTICS—The Shining Willow, also known as Glossy Willow, may be distinguished by its shining leaves which are lanceolate to ovate in outline, and by its glandular petioles and stipules. The shining brownish or yellowish twigs are also characteristic. The capsules are smooth and the staminate flowers usually have 5 stamens.

RANGE—Newfoundland to Manitoba, south to Pennsylvania, west to Kentucky and Nebraska.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State except in the southern part.

HABITAT—Prefers wet habitats. Common along streams, on islands, and in wet semi-boggy situations.

IMPORTANCE OF THE SPECIES—The Shining Willow is a very common shrub or small tree in wet situations throughout this State. The wood is of no commercial importance. The tree often acts as a soil binder upon areas where erosion is to be feared. It is also one of the most attractive of our small Willows, both in its natural haunts and artificial environments.

GLAUCOUS WILLOW

Salix discolor, Muhlenburg

FORM—A shrub or small tree usually from 6-15 feet high but may reach a height of 25 ft. with a diameter of 8 inches. Trunk short and bearing stout ascending branches which form a round-topped crown.

BARK—Thin, smooth, occasionally scaly, reddish-brown.

TWIGS—At first hairy, later smooth, stout, reddish-purple to dark green, rather flexible.

BUDS—Alternate, closely appressed, flattened, pointed, about ¼-½ of an inch long, covered by a solitary shining reddish-purple scale. Flower buds much larger than leaf-buds.

LEAVES—Alternate, simple, elliptic to oblong-lanceolate, sharp-pointed at apex, rounded at base, coarsely toothed on margin, glaucous or white beneath, green and smooth above. Petioles and stipules not glandular.

LEAF-SCARS—Alternate, somewhat raised, lunate, contain 3 bundle-scars.

FLOWERS—Appear in March on twigs of previous season's growth before the leaves unfold. Staminate and pistillate flowers occur on separate trees; catkins densely flowered, with brown-tipped bracts.

FRUIT—A large, hairy, long-beaked, light brown capsule.

WOOD—Same as that of other Willows. See description under Black Willow, page 96.

DISTINGUISHING CHARACTERISTICS—The Glaucous Willow, also known as Pussy Willow, may be distinguished by its lanceolate to elliptic leaves which are smooth and bright green above and glaucous beneath. The blossoms are thick, about half as wide as long. Capsules are pubescent. The scales of the blossoms are clothed with long shining hairs.

RANGE—Nova Scotia and Manitoba, south to Delaware and Missouri.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State. Rather common along the main streams and their tributaries.

HABITAT—Prefers wet habitats such as one finds along streams, on the borders of lakes, in swamps and semi-boggy situations. Occasionally on moist hillsides. Planted specimens often grow on rather dry situations.

IMPORTANCE OF THE SPECIES—The Glaucous Willow produces wood which is of no special commercial importance. The main value of the tree lies in its attractive blossoms which appear early in spring before the leaves have unfolded. It also possesses a rather handsome form and and attractive bark.

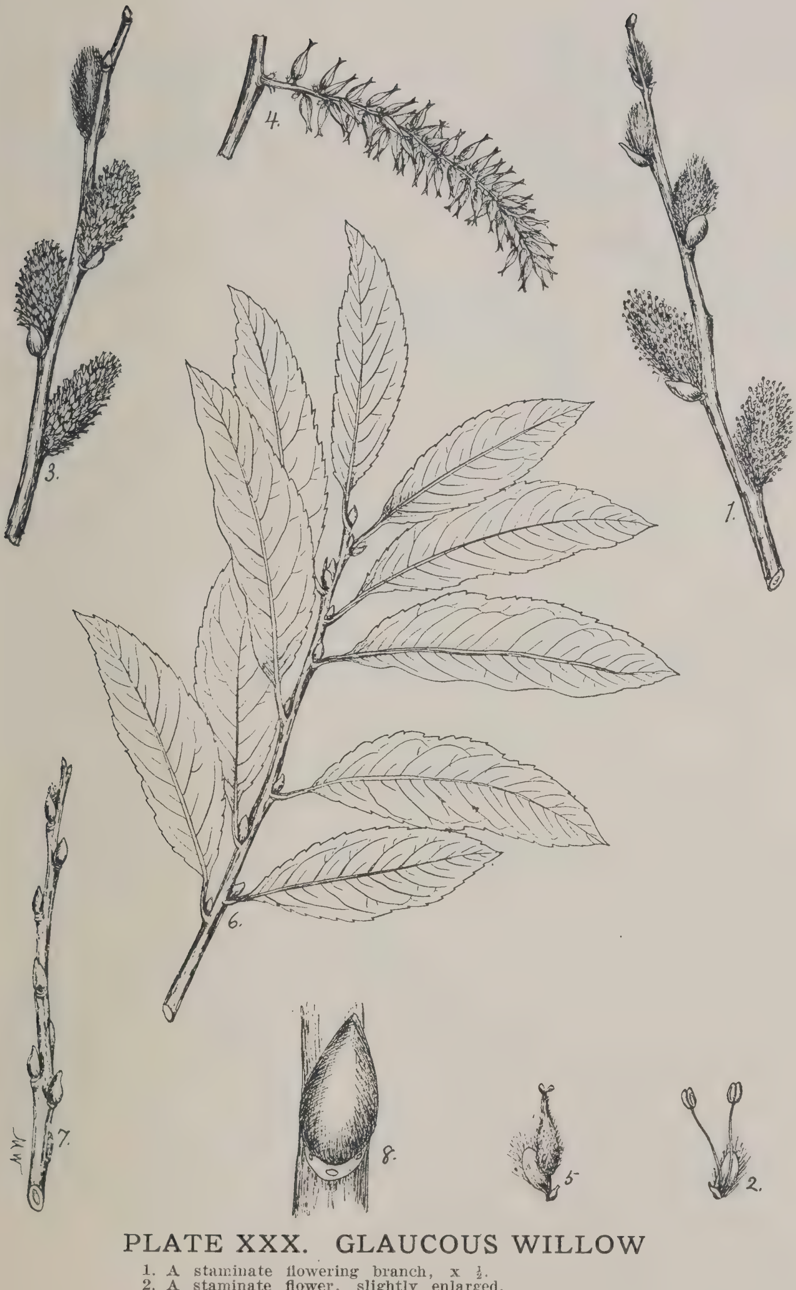

PLATE XXX. GLAUCOUS WILLOW

1. A staminate flowering branch, x ½.
2. A staminate flower, slightly enlarged.
3. A pistillate flowering branch, x ½.
4. Section of a fruiting branch, x ½.
5. A pistillate flower, slightly enlarged.
6. A branch with mature leaves, x ½.
7. A winter twig, x ½.
8. Section of a twig with a bud and leaf-scar, enlarged.

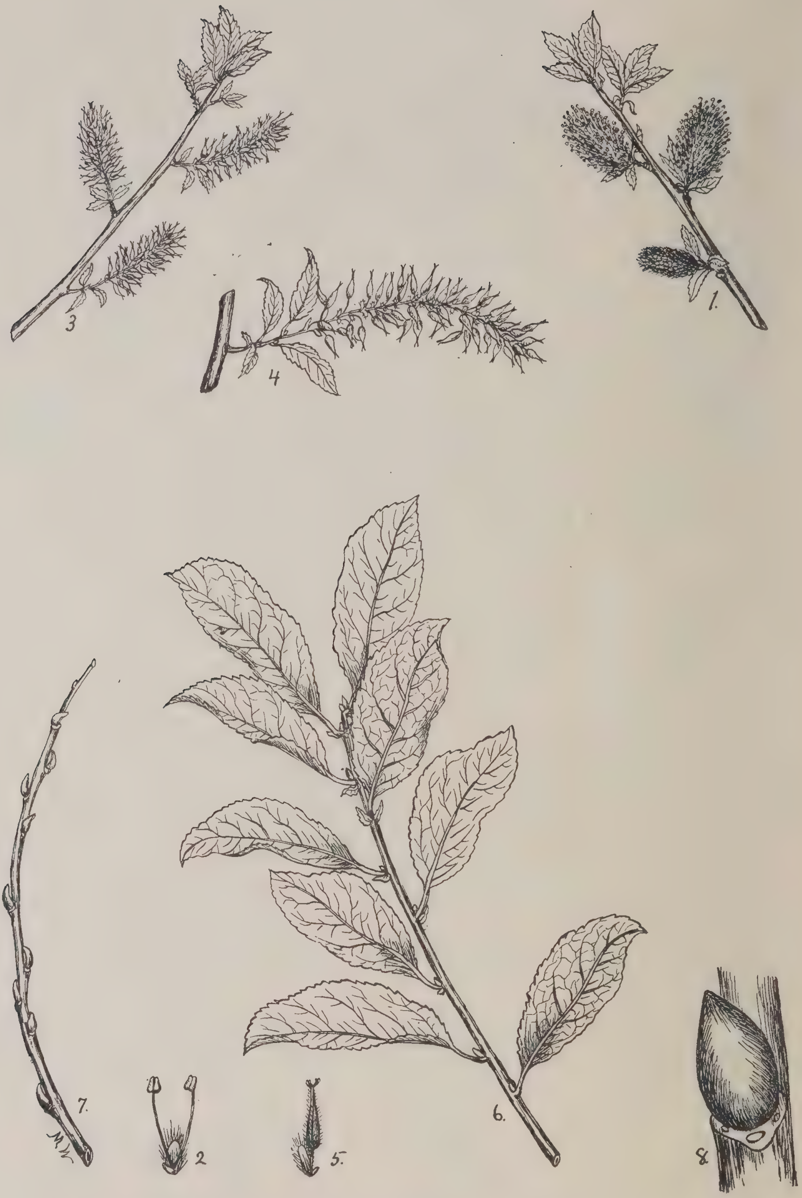

PLATE XXXI. BEAKED WILLOW

1. A staminate flowering branch, x ½.
2. A staminate flower, slightly enlarged.
3. A pistillate flowering branch, x ½.
4. Section of a fruiting branch, x ½.
5. A pistillate flower, slightly enlarged.
6. A branch with mature leaves, x ½.
7. A winter twig, x ½.
8. Section of a twig with a bud and leaf-scar, enlarged,

BEAKED WILLOW

Salix rostrata, Richards

FORM—Shrub or small tree, rarely exceeding 20 ft. in height, usually 6-10 ft. high and 3-4 inches in diameter. Trunk short, often inclined and twisted. Crown broad and round-topped.

BARK—On trunk thin, smooth, sometimes shallowly fissured, usually scaly, bitter, reddish, grayish, or olive-green.

TWIGS—At first hairy, later smooth, slender, purplish to brown, with projecting leaf-scars and few lenticels.

BUDS—Alternate, oblong, narrow, blunt-pointed, about ¼ of an inch long, covered by a single light chestnut-brown scale.

LEAVES—Alternate, simple, elliptic to oblong, lanceolate, short-pointed to sharp-pointed at apex, wedge-shaped or rounded at base, sparingly toothed or entire on margin, dull green and smooth on upper surface, pale green and prominently veined and hairy on lower surface, 1-3 inches long, and ½-1 inch wide.

LEAF-SCARS—Alternate, conspicuous, lunate, somewhat elevated, with 3 conspicuous bundle-scars.

FLOWERS—Appear about April or May before or during the unfolding of the leaves. Pistillate and staminate flowers occur on different trees. The staminate have 2 stamens with smooth filaments and are arranged in erect and terminal catkins about 1 inch long. The pistillate have hairy and evidently-stalked ovaries and are arranged in catkins about 2-2½ inches long.

FRUIT—A narrowly-ovoid, hairy, evidently-beaked and stalked capsule.

WOOD—Diffuse-porous; with very inconspicuous medullary rays. Similar to the wood of other Willows. See description under Black Willow, page 96.

DISTINGUISHING CHARACTERISTICS—The Beaked Willow, also known as Bebb's Willow, may be distinguished by its elliptic to oblong-lanceolate leaves which are usually prominently veined and hairy on lower surface. The pubescent, evidently-stalked and beaked capsules are also characteristic. The bracts of the catkins are yellow while those of the closely related Glaucous Willow are reddish-brown.

RANGE—From the valley of the Mackenzie River within the Arctic Circle and the valley of the St. Lawrence to Alaska, south to Pennsylvania, and west to Minnesota and Idaho. One of the most widely distributed of the Willows.

DISTRIBUTION IN PENNSYLVANIA—Found in the northeastern and northern parts of the State.

HABITAT—Prefers moist or wet situations but will grow on dry hillsides. Common in swamps and along the borders of streams. In Canada often produces twisted stems which form almost impenetrable thickets.

IMPORTANCE OF THE SPECIES—The Beaked Willow is of no commercial and of little economic importance in Pennsylvania. This is its southern limit. It remains small and is not abundant. Like most of the Willows, it grows in wet situations and will aid in binding the soil, thus preventing erosicu and wash-outs.

THE ASPENS AND COTTONWOODS—POPULUS (Tourn.) L.

The genus Populus comprises about 27 species native to the north temperate and arctic zones, of which number 19 are native to North America and 4 to Pennsylvania.

The trees belonging to this genus have many common names, as Aspens, Cottonwoods, Poplars, or Popples. Although some of them are called Poplar, still they are in no way related to the well-known Yellow Poplar or Tulip Tree which belongs to the Magnolia family.

The leaves of some of the representatives become very conspicuous on account of their trembling or quaking habit. This fluttering of the leaves, even when only a slight breeze is at hand, is due to their laterally compressed leaf-stalks. The buds of a few species are evidently resinous and often pungent. Possibly no group of trees, except the Willows, is so well equipped to disseminate its seeds. The seeds are very light, produced in great abundance, and furnished with a dense covering of long white hairs which aid in their dispersal.

The wood of this group of trees is just beginning to be of commercial importance. It was formerly despised but is now used for various purposes, especially for paper pulp. These trees have some valuable merits in that they grow very fast, often on situations where other species refuse to grow, especially in wet places, and may easily be reproduced by cuttings, sprouts, or seeds.

In addition to the 4 species described, and contained in the subjoined key, a few other species are rather common throughout the State especially as ornamental trees. The White or Silver-leaf Poplar (Populus alba L.) is a native of Europe and Asia but very common as an ornamental tree. It can be distinguished by its lobed leaves, covered by a dense white persistent wool on the lower surface, and by its twigs, usually covered with white cottony felt which rubs off easily. The Lombardy Poplar (Populus nigra var. italica Du Roi) is frequently cultivated in this State. It can best be distinguished by its form (Fig. 55). The lateral branches are almost erect forming a high but narrow crown. The leaves have flattened petioles, are finely toothed, smooth, and sharp-pointed. The Balm of Gilead (Populus candicans Ait.), sometimes regarded a variety of the Balsam Poplar, is occasionally found as a cultivated tree and frequently escapes cultivation. It can be recognized by large resinous buds, reddish-brown twigs, and its ovate leaves with round or channeled petioles and heart-shaped base. The leaves of the closely related Balsam Poplar (Populus balsamifera L.) do not have a cordate base.

SUMMER KEY TO THE SPECIES

Page

1. Leaves with round or channeled petioles; twigs with orange colored pith, **P. heterophylla** 104
1. Leaves with flattened petioles; twigs with white pith, ...2

2. Leaves broadly deltoid, abruptly acuminate; stigma-lobes expanded in all directions, ...**P. deltoides** 105
2. Leaves broadly ovate to nearly round, usually acute at apex; stigma-lobes thread-like, ...3

3. Leaves finely serrate on margin; bark greenish-white, ...**P. tremuloides** 102
3. Leaves coarsely dentate on margin; bark yellowish-gray to black, ...**P. grandidentata** 103

WINTER KEY TO THE SPECIES

1. Terminal buds about ¼ of an inch long, devoid of resin or only slightly resinous; lateral ency to become vertical, ...**P. deltoides** 105
1. Terminal buds about ¼ of an inch long, devoid of resin or only slightly resinous; lateral branches without the vertical tendency, ...2

2. Twigs with orange-colored pith, ...**P. heterophylla** 104
2. Twigs with white pith, ...3

3. Buds smooth, glossy, conical, sharp-pointed; often incurved and closely appressed, bark greenish-white, ...**P. tremuloides** 102
3. Buds downy, dull, ovate, blunt-pointed; straight, divergent; bark yellowish-gray to black, ...**P. grandidentata** 103

AMERICAN ASPEN

Populus tremuloides, Michaux

FORM—A small tree usually 30-40 ft. high but may reach a height of 80 ft. with a diameter of 20 inches. In Pennsylvania usually very small. Trunk continuous, tapering, bearing slender, brittle, and rather ascending lateral branches. Crown high, narrow, rather round-topped.

BARK—On old trunks thick, deeply fissured and black; on upper portion of trunk and young stems yellowish-green to white, with dark blotches below the branches. Usually whiter at high altitudes.

TWIGS—Rather slender, reddish-brown, glossy, smooth, round, sometimes covered with a scaly bloom; marked by reddish-yellow lenticels; roughened by leaf scars; pith white and 5-angled.

BUDS—Alternate, narrowly conical, sharp-pointed, smooth, shiny, usually appressed, often incurved; covered by 6-7 reddish-brown, smooth, shiny, bud-scales; basal scale of lateral buds outside.

LEAVES—Alternate, simple, ovate to nearly round, cordate to truncate at base, acute at apex, finely serrate on margin, 1½-2 inches long, thin, dark green and shiny above, pale green below. Leaf-stalks laterally flattened.

LEAF-SCARS—Alternate, large, conspicuous, lunate, with a cork-like surface; bundle-scars 3, simple or compounded. Stipulate-scars linear, blackish, rather distinct.

FLOWERS—Appear about April. Staminate and pistillate flowers occur on different trees. Staminate aments are drooping, 1½-2½ inches long, bearing many closely packed individual flowers with 6-12 stamens. Pistillate aments are drooping, 1½-2½ inches long; when mature 4 inches long, bearing relatively few individual flowers with thick stigmas divided into thread-like lobes.

FRUIT—An oblong conical capsule, 2-valved, light green, borne on a drooping stalk about 4 inches long. Seeds light brown, surrounded by a mat of long, soft, white hairs.

WOOD—Diffuse-porous; medullary rays very fine and indistinct; pores very minute, invisible without a lens. Fine in texture, light brown to white in color, neither strong nor durable. Weighs 25 lbs. per cubic foot. Used for paper pulp, boxes, jelly buckets, lard pails, spice kegs, wooden dishes.

DISTINGUISHING CHARACTERISTICS—The American Aspen, also known as Quaking Aspen, Trembling Aspen, Small-toothed Aspen, Popple, Poplar, and Aspen, may be distinguished by the round or ovate leaves which have a finely serrate margin and are short-pointed. The petioles of the leaves are decidedly flattened which causes them to tremble or flutter in response to even a light breeze, whence the name Trembling Aspen. The alternate, sharp-pointed, conical, often incurved, closely appressed, shiny buds are also characteristic. The buds of the closely related Large-toothed Aspen are stouter, not so sharp-pointed, usually divergent, and covered with a flour-like, crusty, pale, wooly substance. The twigs are reddish and usually smooth while those of the Large-toothed Aspen are yellowish-brown often pale-downy or pale-scaly. The lateral branches are more ascending and the bark is lighter in color than that of the Large-toothed Aspen. The bark is yellowish-green to white often marked with dark blotches.

RANGE—A transcontinental species extending from Newfoundland to the Hudson Bay region and Alaska, south to Pennsylvania and along the mountains to Kentucky, west to the Rocky Mountains, Mexico, and California. The widest range of any tree in North America.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State. Commonest in the mountainous part. Rare and small in the southern part. Abundant on cut-over and recently burned areas in northern part. The writer counted 24,792 specimens per acre of this tree upon a recent lumbered area in Lycoming county.

HABITAT—Found upon practically all soil conditions except swamps. Prefers dry situations. Common in abandoned fields, on cut-over areas and burns. Frequently mixed with Fire Cherry and Scrub Oak. The latter shades out in time.

IMPORTANCE OF THE SPECIES—The American Aspen is of no commercial importance in Pennsylvania. It remains too small and is too local in its distribution. Next to Spruce and Hemlock it is the principal pulpwood of the country. It is also beginning to be used for lumber. The wood is white and turns well. Ordinarily it is a poor competitor in the forest but it does overcome the Scrub Oak upon burnt-over areas by shading it out. It is also valuable as a temporary shelter species for other valuable trees.

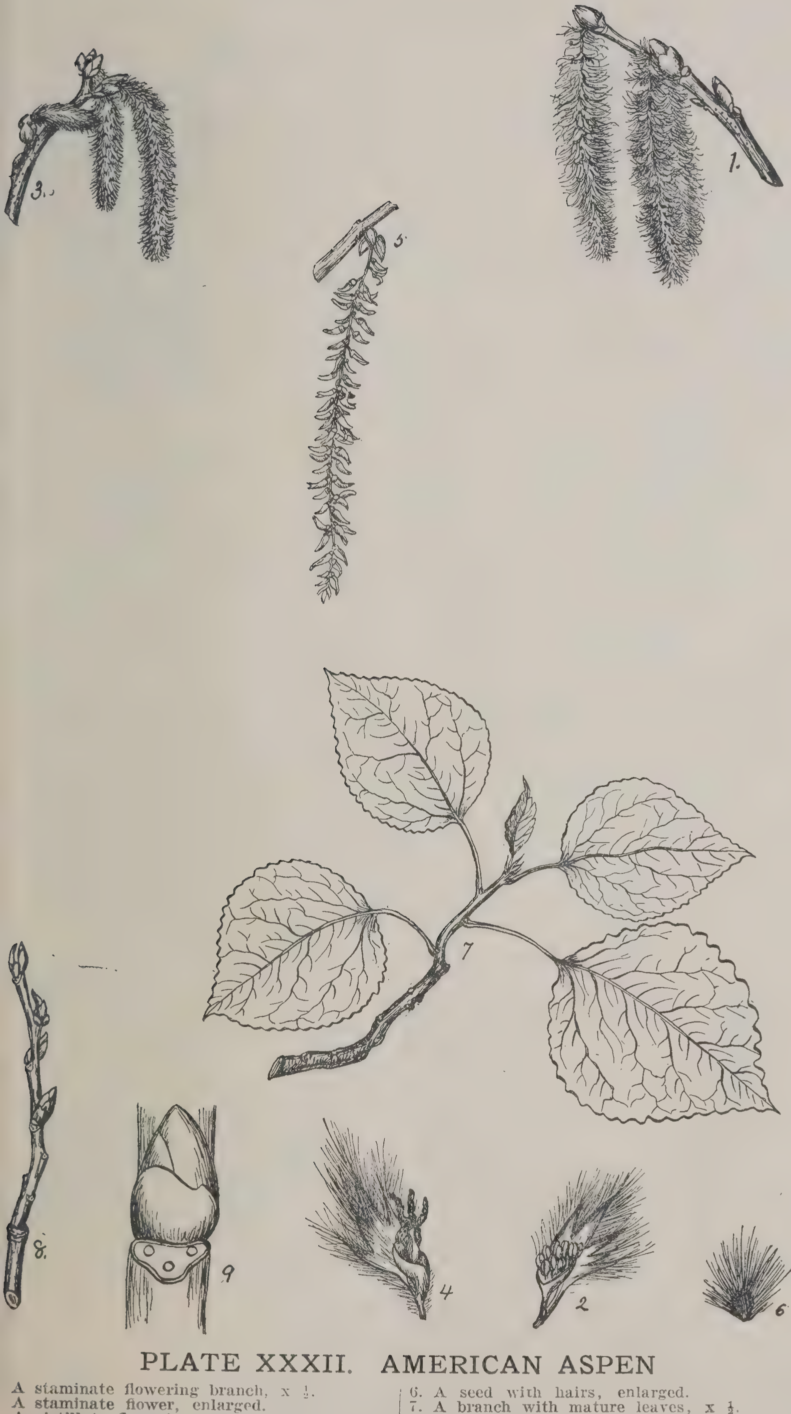

PLATE XXXII. AMERICAN ASPEN

A staminate flowering branch, x ½.
A staminate flower, enlarged.
A pistillate flowering branch, x ½.
A pistillate flower, enlarged.
Section of a fruiting branch, x ½.

6. A seed with hairs, enlarged.
7. A branch with mature leaves, x ½.
8. A winter twig, x ½.
9. Section of a twig with a bud and a leaf-scar, enlarged.

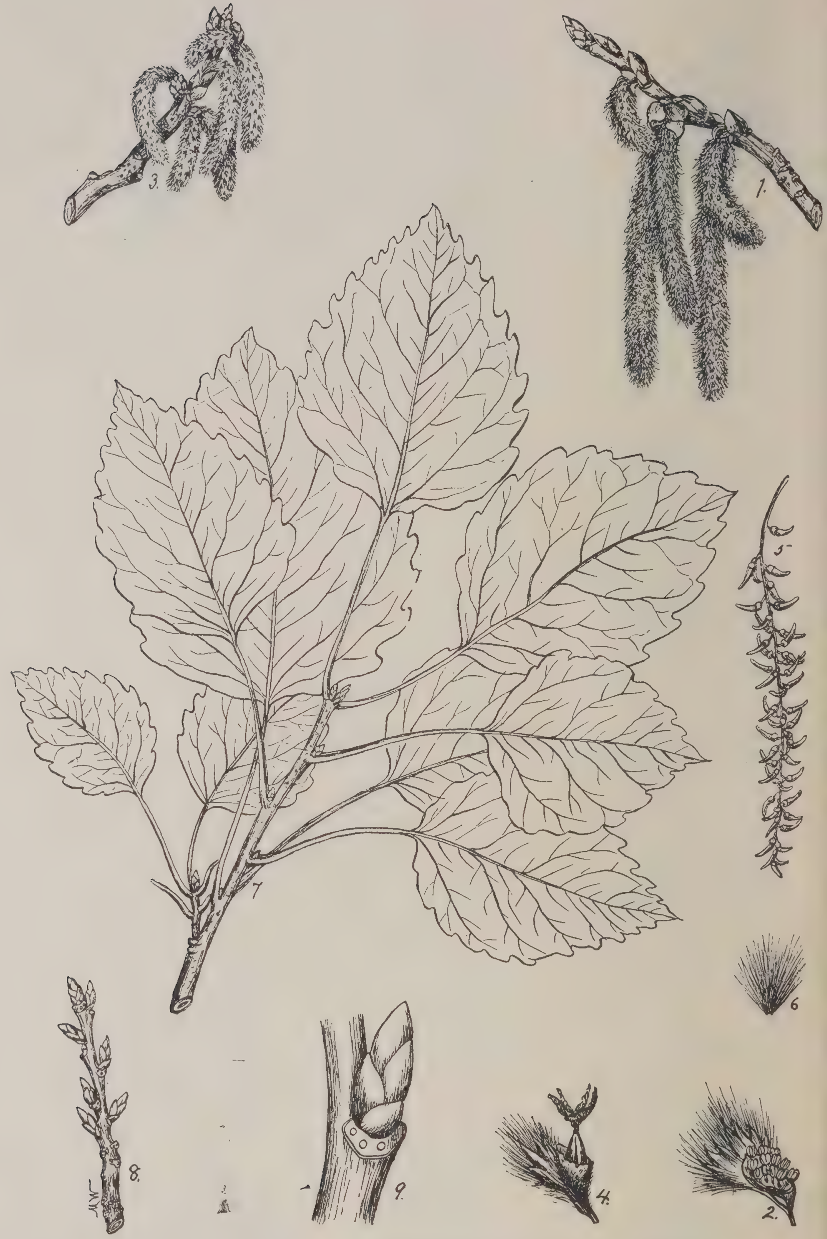

PLATE XXXIII. LARGE-TOOTHED ASPEN

1. A staminate flowering branch, x ½.
2. A staminate flower, enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, enlarged.
5. A fruiting catkin with capsules, x ½.
6. A seed with hairs, enlarged.
7. A branch with mature foliage, x ½.
8. A winter twig, x ½.
9. Section of a winter twig, enlarged.

LARGE-TOOTHED ASPEN

Populus grandidentata, Michaux

FORM—Usually a small tree 30-40 ft. high but may reach a height of 70 ft. with a diameter of 2 feet. More frequent and larger in this State than the American Aspen. Trunk continuous and tapering. Crown often irregular, due to the absence of branches which have been broken off on account of their brittleness. Branches usually less ascending than those of the American Aspen.

BARK—Near the base of old trunks black, very rough, thick, hard, does not heal over branch wounds rapidly. Large smooth surfaces found on flat ridges between fissures. Smaller branches similar to those of the American Aspen but with a more pronounced yellow color. See Fig. 114.

TWIGS—Rather stout, reddish to yellowish-brown, round, often covered with a coating of pale, woolly, crusty down which occasionally peels off in small flakes.

BUDS—Alternate, ovate to conical, pointed, dusty, dull, usually divergent, covered by 6-7 light chestnut-brown scales which are often coated with a dusty flour-like mat of a pale, woolly substance. Basal scale of lateral buds on outside.

LEAVES—Alternate, simple, broadly-ovate, wedge-shaped to cordate at base, acute to acuminate at apex, coarsely dentate on margin, 3-4 inches long, dark green above, pale green below. Leaf-stalks laterally flattened.

LEAF-SCARS—Same as leaf-scars of American Aspen, page 102. Stipulate-scars are less distinct.

FLOWERS—See "Flowers" under American Aspen, page 102.

FRUIT—An ament bearing scattered, light, green, 2-valved capsules which contain minute dark brown seeds surrounded by a mat of long white hairs.

WOOD—Same as American Aspen, page 102.

DISTINGUISHING CHARACTERISTICS—The Large-toothed Aspen, also known as Popple and Poplar, may be distinguished by its coarsely wavy-toothed leaves, larger than those of the American Aspen which it closely resembles. See "Distinguishing Characteristics" under the latter. It does not have the resinous buds, nor the ridged bark on the twigs, nor the deltoid leaves so characteristic of the Cottonwood. The bark is often covered with oyster-shell-like bodies which are the armored portion of the Oyster-shell Scale. Many small trees are killed by this scale.

RANGE—Novia Scotia and Ontario south to Pennsylvania, along mountains to North Carolina and west to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Rather common throughout the State especially on lumbered and burnt-over areas, in abandoned fields, and on charcoal hearths. Usually found in mixture, but occasionally in small pure stands.

HABITAT—Prefers rather rich moist soil, but is also found on dry gravelly soil. Usually large on moist situations and smaller, often scrubby, on very dry situations. Frequent associates are Birch, Bird Cherry, Shad Bush, and Scrub Oak.

IMPORTANCE OF THE SPECIES—The Large-toothed Aspen is of no commercial importance in this State. It is of value in our lumbered areas because it covers the soil rapidly, acts as a soil-conserver, and often as a soil-improver. It may also act as a temporary shelter for more valuable trees while they are young and establishing themselves. It also aids in shading out the most aggresive forest weed—Scrub Oak.

DOWNY POPLAR

Populus heterophylla, Linnaeus

FORM—In the north usually a small tree from 30-50 ft. high; in the south may reach a height of 100 ft. with a diameter of 3 ft. Crown high, rather broad and round-topped. Trunk short, continuous, and tapering.

BARK—On old trunks thick, light reddish-brown, rough, broken by long fissures into long narrow plates. On younger trunks and large branches thinner, not so rough; fissures shallower and ridges smoother than on old trunks.

TWIGS—Stout, light yellowish, marked by a few scattered pale lenticels, roughened by elevated leaf-scars; pith orange-colored.

BUDS—Alternate, broadly ovate, slightly resinous, bright reddish-brown, covered with 4-7 scales which are slightly pubescent towards the base. Leaf-buds about ¼ of an inch long. Flower-buds about ½ of an inch long.

LEAVES—Alternate, simple, broadly ovate, cordate, rounded or truncate at base, rounded or acute at apex, coarsely serrate on margin, 4-7 inches long, dark green above, pale green below; leaf-stalks round.

LEAF-SCARS—Alternate, large, elevated, often 3-lobed, indented on upper margin; with 3 conspicuous bundle-scars.

FLOWERS—Appear in March or April. In general similar to the Cottonwood, only both staminate and pistillate aments are shorter.

FRUIT—A drooping ament, when mature about 4-6 inches long, bearing a few, scattered, dark green 3-4 valved capsules containing small seeds surrounded by a mat of white hairs.

WOOD—Same as that of the Cottonwood only slightly heavier. See description page 105.

DISTINGUISHING CHARACTERISTICS—The Downy Poplar, also known as Swamp Cottonwood, Black Cottonwood, River Cottonwood, and Swamp Poplar, may be distinguished from all the Aspens, Poplars, and Cottonwoods native to this State by its round leaf-stalks. The leaf-stalks of all the others are laterally flattened. The leaves are large and more bluntly pointed than those of the other species. The leaf-margins are not so finely toothed as those of the American Aspens but finer than the other two native species. The bark on old trunks is light reddish-brown. The twigs are stouter than those of the Aspens and contain orange colored pith. The Aspens have white pith. The buds are bright reddish-brown, slightly resinous, covered with scales which are often pubescent near the base.

RANGE—Connecticut along coast to Georgia, west to Louisiana, and northward to Kentucky and Missouri. Its range suggests a somewhat contorted horseshoe.

DISTRIBUTION IN PENNSYLVANIA—Reported from Chester, Delaware, and Franklin counties. Very rare and local. Recent investigations indicate that this tree is probably not native to the State.

HABITAT—Found only in low and wet situations, and always mixed with other species in this State.

IMPORTANCE OF THE SPECIES—The Downy Poplar is too rare and local to be of any commercial importance. It is not attractive ornamentally on account of its heavy limbs and spare, rounded crown. The wood is not listed separately on the market but bought and sold as Cottonwood.

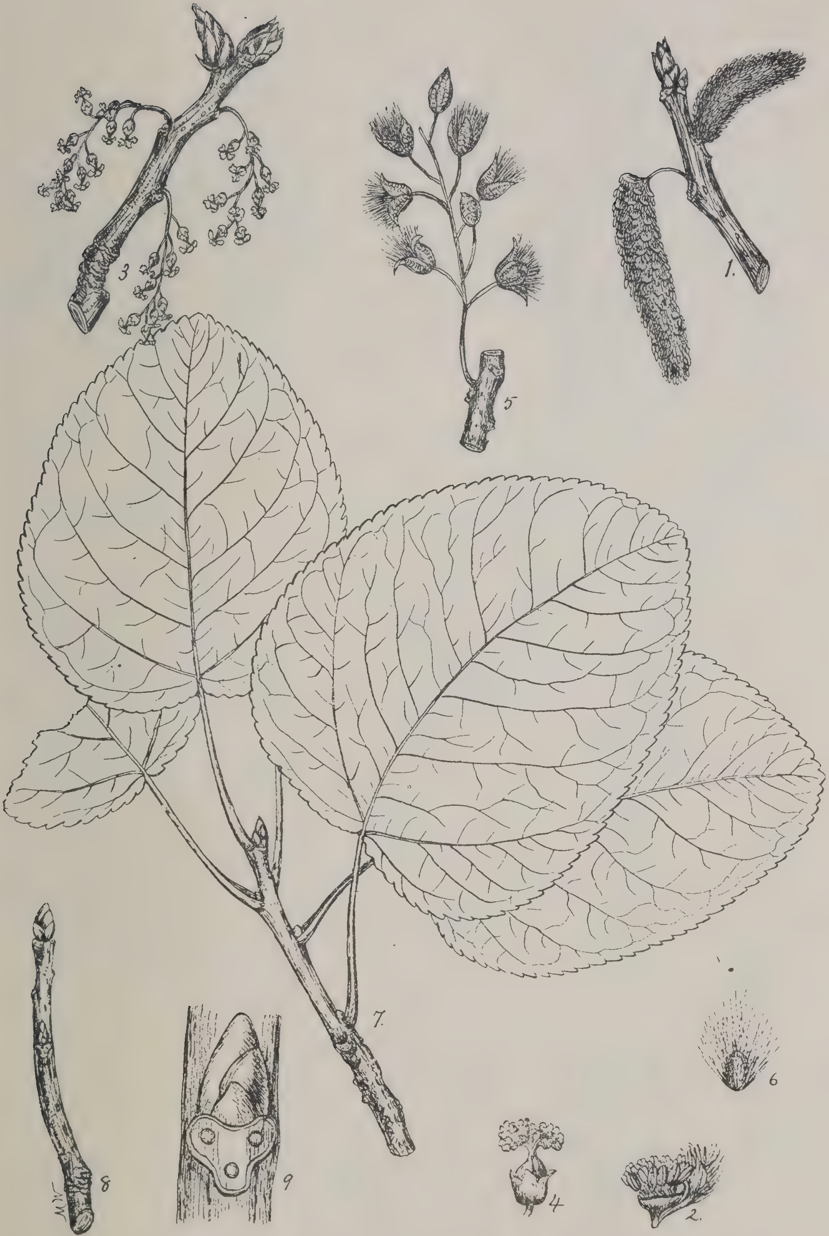

PLATE XXXIV. DOWNY POPLAR

1. A staminate flowering branch, x ½.
2. A staminate flower, enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, enlarged.
5. Section of a branch with a fruiting catkin and capsules, x ½.
6. A seed with hairs, enlarged.
7. Section of a branch with mature foliage, x ½.
8. A winter twig, x ½.
9. Section of a winter twig, enlarged.

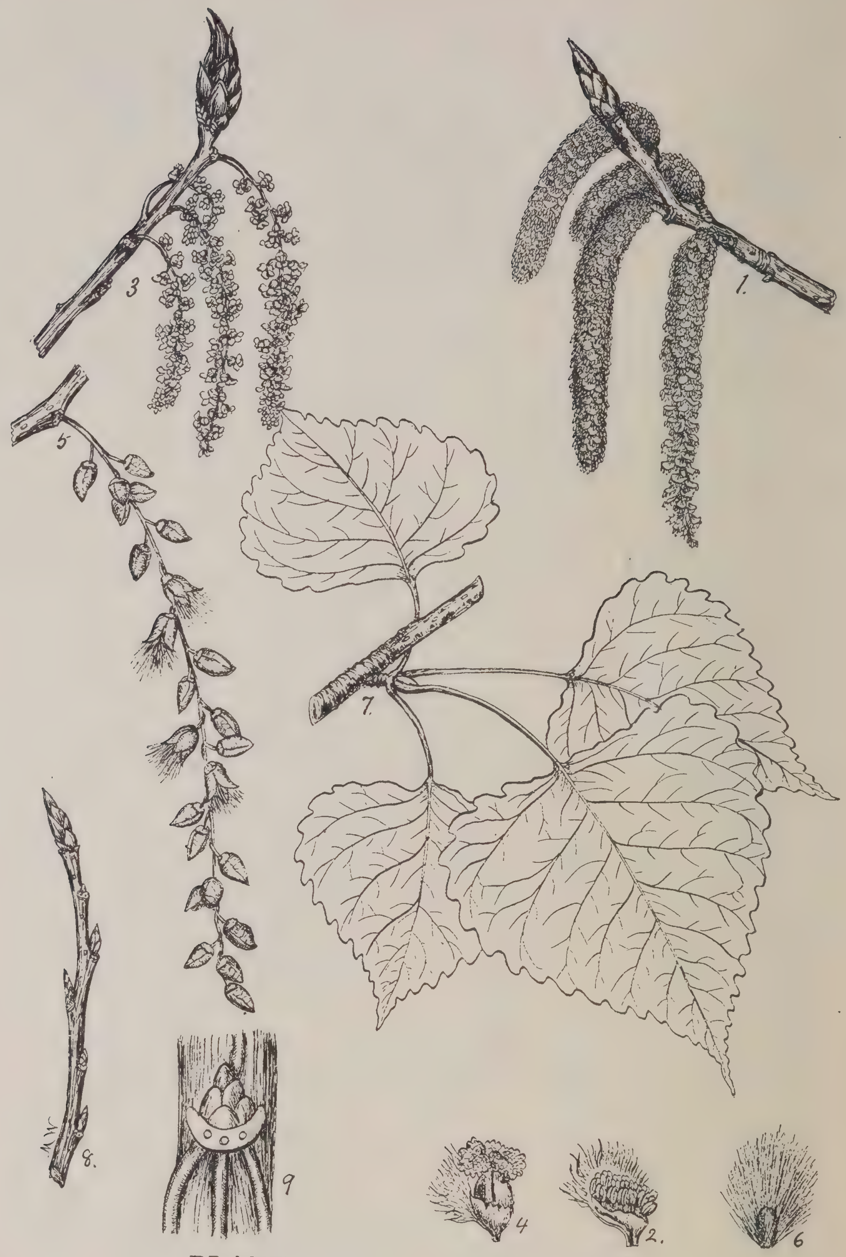

PLATE XXXV. COTTONWOOD

1. A staminate flowering branch, x ½.
2. A staminate flower, enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, enlarged.
5. A fruiting catkin with capsules, x ½.
6. A seed with hairs, enlarged.
7. A branch with mature foliage, x ½.
8. A winter twig, x ½.
9. Section of a winter twig, enlarged.

COTTONWOOD

Populus deltoides, Marshall

FORM—A large tree usually 50-75 ft. high but may reach a height of more than 100 ft. with a diameter of 6 feet. Trunk tapering, continuous, sometimes clean for a considerable distance from the ground. Crown usually high and pyramidal. Lower lateral branches horizontal, while most of the upper branches are decidedly ascending.

BARK—On old trunks thick, ashy-gray, roughened by long deep furrows which are usually longitudinally parallel, and often connect with one another. Rather thin, smooth, and greenish-yellow on younger trunks.

TWIGS—Stout, usually yellow tinged with green or brown, round or ridged below the buds; covered with large, longitudinally-elongated lenticels; pith white and angular.

BUDS—Alternate, large, resinous, glossy, smooth, chestnut-brown, covered with numerous bud-scales which are sticky, resinous on the interior and smooth on the exterior. Terminal buds often 5-angled and larger than lateral ones; lateral buds usually divergent and often recurved.

LEAVES—Alternate, simple, broadly deltoid, truncate to wedge-shaped at base, acuminate at apex, coarsely serrate on margin, 3-5 inches long, thick, deep shining green above, pale green below. Leaf-stalks laterally flattened.

LEAF-SCARS—Alternate, large, lunate, elevated, depressed on upper margin, sometimes 3-lobed; with 3 bundle-scars. Stipule-scars dark and conspicuous.

FLOWERS—Appear about March or April. Staminate and pistillate flowers occur on different trees. The staminate are arranged in drooping aments 3-4 inches long and are densely flowered; the pistillate occur in drooping aments 2½-3¼ inches long and sparsely flowered.

FRUIT—A drooping ament bearing dark green 3-4 valved capsules which contain small seeds surrounded with a mat of long white hairs. Fruiting aments 8-12 inches long.

WOOD—Diffuse-porous; with very indistinct rays; pores in early wood visible to unaided eyes; heartwood dark brown; sapwood wide and white; wood is soft, warps easily, and is difficult to split. Weighs about 23 lbs. per cubic foot. Used for paper pulp, boxes, crates, berry boxes, pails, and tubs.

DISTINGUISHING CHARACTERISTICS—The Cottonwood, also known as Carolina Poplar, Cotton Tree, and Whitewood may readily be distinguished at any season of the year by its lateral branches, which have a tendency to ascend like the Lombardy Poplar (Fig. 55), and by its yellowish twigs which often have prominent ridges running down from the leaf-scars. The buds are larger, more resinous, and often more flattened than those of any other member of this genus; usually divergent and often incurved. The leaves are very characteristic since they have laterally flattened leaf-stalks, are deltoid in outline, truncate at the base and long-pointed at the apex. The pores in the early wood are visible to the unaided eye while those of the American and Large-toothed Aspens are not visible.

RANGE—Quebec and Ontario south to Florida, west to the Rocky Mountains.

DISTRIBUTION IN PENNSYLVANIA—Natural distribution is very limited. Reported from Presque Isle, Erie county, and from Lancaster county. Locally escaped cultivation. Planted extensively for ornamental purposes and in a few plantations for forestry purposes. A large plantation is growing near Hollidaysburg in Blair county.

HABITAT—Prefers rich moist soil, like banks of streams, borders of lakes, and semi-swamps.

IMPORTANCE OF THE SPECIES—The Cottonwood is planted extensively as an ornamental tree but as such it has few merits except its rapid growth, rather attractive form in winter, and the pleasant balsamic odor from its coated, young, developing leaves. It is well adapted to wet locations and may be planted where other more valuable trees will not grow. It grows rapidly, and produces an excellant pulp-wood. This tree is known to grow 5 feet in a single year and 40 feet in 10 years. Cuttings taken from trees and placed in the ground grow very readily. When planted in the streets its roots often lift pavements, and clog drains and sewers. It is not adapted for street planting.

THE WALNUT FAMILY—JUGLANDACEAE

This family comprises about 6 genera with 35 species of trees and shrubs found chiefly in the warmer portion of the north temperate zone. Two genera with about 19 species are native to North America. Both of these genera, Juglans and Carya, have representatives in Pennsylvania. The genus Juglans has 2 species and the genus Carya has 5 species native to the State. In addition to the existing species a great number of fossil species have been referred to this family. Thirty fossil species belonging to the genus Juglans and 10 species belonging to the Carya have been described.

This is one of the most important families of trees native to Pennsylvania. Both the Hickories and the Walnuts yield very valuable wood. The wood of the Walnuts is esteemed especially for cabinet work and that of the Hickories on account of its strength and flexibility. The bark and husks of the Walnuts are used sometimes as a dyestuff. The fruit of both genera is edible.

The staminate and pistillate flowers are separate but borne on the same tree and usually on the same branch. The staminate flowers are in long drooping aments while the pistillate appear as buds and occur in small few-flowered clusters. The leaves of both genera are compound and alternate. The fruit is a nut. The nut of the Walnuts is sculptured and covered with a fleshy, indehiscent, pulpy husk while the nut of the Hickories is not sculptured but is covered with a dehiscent husk.

KEY TO THE GENERA

	Page
1. Pith of twigs chambered; nuts sculptured or rugose with indehiscent husk; staminate catkins thick, compact, usually sessile and solitary; wood diffuse-porous, ...**Juglans**	107
1. Pith of twigs continuous; nuts smooth or ridged with dehiscent husk; staminate catkins slender, loose, long-stalked, in 3s; wood ring-porous, ...**Carya**	110

THE WALNUTS—JUGLANS, L.

This genus comprises about 15 species which are found chiefly in the north temperate zone. Five species are native to North America, two of these are found in Pennsylvania. In addition to the native species, a European species known as the English Walnut (Juglans regia L.) is widely distributed in the United States as an ornamental tree. It is this European species which yields the valuable Circassian Walnut wood used so extensively in the manufacture of furniture and it also produces the English walnuts so common in our markets.

Our native species produce materials which are of considerable commercial importance. The wood is highly prized. The nuts are delicious and valuable as a food. The bark and husks are used as dyes and tans. The wood of our walnuts is diffuse-porous and brown to black in color. The leaves are alternate and compound. The pith is chambered. The fruit ripens in one season and consists of a sculptured or rugose nut covered by a pulpy husk which does not split open into regular segments. The kernel of the nut is 2-4 lobed, large and oily. The nuts are scattered mainly by rodents, which bury them for food, and by floods which carry them along their courses.

SUMMER KEY TO THE WALNUTS

Page

1. Leaflets 11-17, often viscid-hairy, the terminal leaflet usually present; pith dark brown; bark gray; fruit sticky-hairy; nut elongated-ovate, ...J. cinerea 108

1. Leaflets 13-23, not viscid-hairy, the terminal leaflet often absent; pith light brown; bark dark brown; fruit sticky-hairy; nut globose, ...J. nigra 109

WINTER KEY TO THE WALNUTS

1. Bark gray; pith dark brown; nut elongated-ovate; upper surface of leaf-scar not notched; hairy transverse fringe above leaf-scar present; terminal buds evidently flattened, not less than ⅓ of an inch long, ...J. cinerea 108

1. Bark dark brown; pith light brown; nut globose; upper margin of leaf-scar notched; hairy fringe above leaf-scar absent; terminal buds slightly flattened, ⅓ of an inch or less in length, ...J. nigra 109

BUTTERNUT

Juglans cinerea, Linnaeus

FORM—A small to medium-sized tree usually attaining a height of 30-50 ft. with a diameter of 1-2 ft., but may reach a height of 80-100 ft. with a diameter of 3-4 feet. Trunk usually short, like that of the apple tree. Crown usually broad, deep, round-topped, rather open, often unsymmetrical.

BARK—On branches and young trunks rather smooth, light gray; on older trunks roughened by black fissures which separate wide, smooth, light gray ridges. Inner bark bitter, light in color, becoming yellow on exposure. See Fig. 99.

TWIGS—Alternate, stout, round; at first hairy and sticky, later smooth; roughened by leaf-scars, bitter to taste, greenish-gray to buff in color, covered with a few pale lenticels; pith chambered, dark brown. If chewed, twigs and young bark color the saliva yellow.

BUDS—Alternate, covered with dense pale down. Terminal bud ½-¾ of an inch long, flattened, blunt-pointed, with its outer scales lobed. Lateral buds smaller than terminal, ovate, very blunt-pointed, often superposed. Scaly cone-like lateral buds often present. These are in reality partially developed catkins.

LEAVES—Alternate, compound, 15-30 inches long, with 11-17 leaflets. Leaflets 3-5 inches long, serrate on margin, acute at apex, unequally rounded at base and usually sessile or nearly so. Petioles hairy and sticky.

LEAF-SCARS—Alternate, large, 3-lobed, concave, with raised margins, with 3 clusters of bundle-scars arranged in a U-shaped line. Upper margin of leaf-scar usually convex, rarely notched.

FLOWERS—Appear about May when leaves are half developed. Staminate and pistillate flowers separate, but occur on the same tree and usually on the same branches. Staminate arranged in unbranched catkins, which become 3-5 inches long. Pistillate produced in 6-8-flowered spikes.

FRUIT—An elongated-ovate sculptured nut covered with a fleshy indehiscent husk. Husk very hairy and sticky. Nut four-ribbed, pointed at one end; contains a sweet edible and very oily kernel.

WOOD—Diffuse-porous with ring-porous tendency; with inconspicuous medullary rays; soft, not strong, light brown, and coarse-grained. Weighs 25 lbs. per cubic foot. Used in furniture, interior finishings, and occasionally in church altars, ceiling, and flooring.

DISTINGUISHING CHARACTERISTICS—The Butternut, also known as White Walnut and Oilnut, resembles the Black Walnut, but is distinguished from it by its shorter and light-barked trunk, dark brown pith, larger and more flattened terminal buds, lighter colored wood, elongated-ovate fruit, and unnotched upper margin of the leaf-scar with a hairy fringe above it.

RANGE—New Brunswick and Quebec, west to Minnesota, and south to Delaware and Arkansas, and along the mountains to Georgia.

DISTRIBUTION IN PENNSYLVANIA—Local throughout the State in rich bottom lands and on fertile hillsides. Very common locally in the southeastern and southern parts. It is commoner in the northern part of the State than the Black Walnut, and in the southern part it ascends the mountains to higher elevations than the Black Walnut.

HABITAT—Prefers rich moist soil. Common along fences, streams, and roads. Occasionally found on high mountains.

IMPORTANCE OF THE SPECIES—The Butternut can hardly be classed as a valuable timber tree. It produces a beautiful wood and delicious nuts but the trees seldom reach a large size. The old trees are very susceptible to the attack of wood-destroying fungi. The tree is attractive ornamentally. It branches freely, often forming many crooks and crotches which yield the highly figured wood.

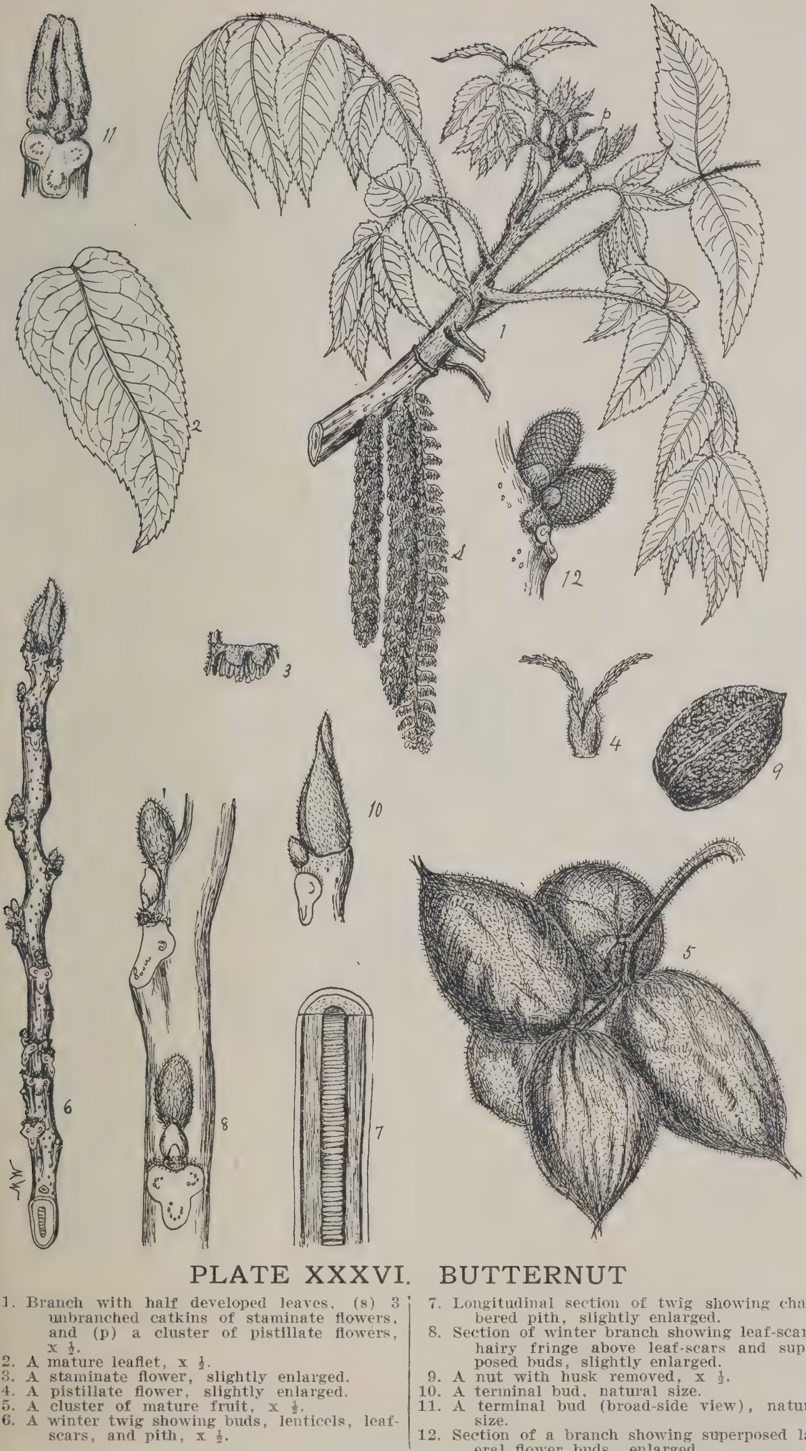

PLATE XXXVI. BUTTERNUT

1. Branch with half developed leaves. (s) 3 unbranched catkins of staminate flowers, and (p) a cluster of pistillate flowers, x ½.
2. A mature leaflet, x ½.
3. A staminate flower, slightly enlarged.
4. A pistillate flower, slightly enlarged.
5. A cluster of mature fruit, x ½.
6. A winter twig showing buds, lenticels, leaf-scars, and pith, x ½.
7. Longitudinal section of twig showing chambered pith, slightly enlarged.
8. Section of winter branch showing leaf-scars, hairy fringe above leaf-scars and superposed buds, slightly enlarged.
9. A nut with husk removed, x ½.
10. A terminal bud, natural size.
11. A terminal bud (broad-side view), natural size.
12. Section of a branch showing superposed lateral flower buds, enlarged.

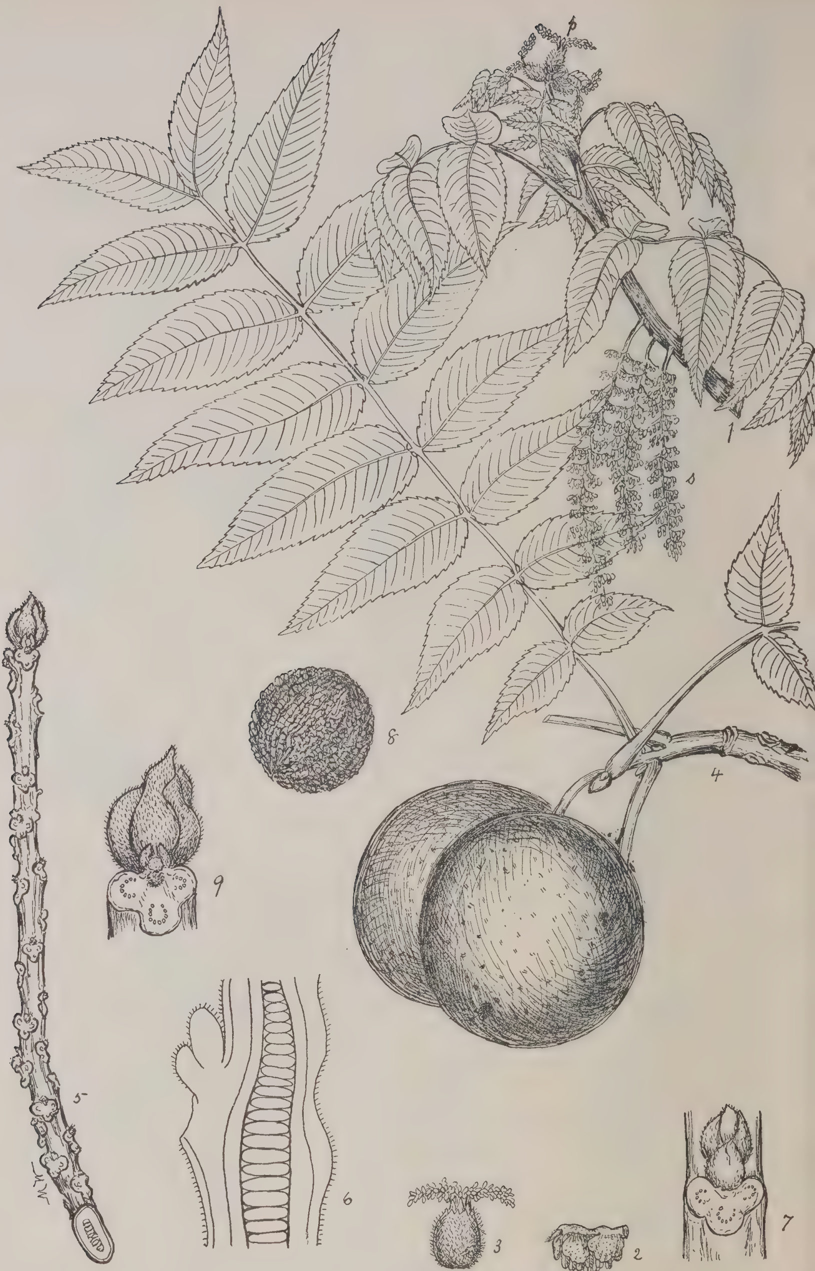

PLATE XXXVII. BLACK WALNUT

1. Branch with developing leaves and (s) three solitary catkins of staminate flowers and (p) a spike with three pistillate flowers, x ½.
2. A staminate flower, slightly enlarged.
3. A pistillate flower, slightly enlarged.
4. A branch with a mature leaf and fruit, x ½.
5. A winter twig, x ½.
6. Longitudinal section of twig showing chambered pith, enlarged.
7. Section of twig showing superposed and gaping buds, and leaf-scars with 3 clusters of bundle-scars and notched upper surface, slightly enlarged.
8. A nut with husk removed, x ½.
9. Terminal section of winter twig showing leaf-scar and terminal bud with bud-scales, slightly enlarged.

BLACK WALNUT

Juglans nigra, Linnaeus

FORM—A large tree, usually attaining a height of 80-100 ft. with a diameter of 2-3 ft., but may reach a height of 150 ft. with a diameter of 6-8 feet. Trunk usually straight, clean, slightly tapering, bearing a round-topped crown.

BARK—Semi-fibrous, thick, rough, longitudinally and occasionally diagonally fissured. Outer bark dark brown to grayish-black. Inner bark light colored, but turns yellow upon exposure. See Fig. 100.

TWIGS—At first hairy, later smooth, orange-brown to dark brown, stout, covered with rather inconspicuous, somewhat raised lenticels; pith light brown, chambered.

BUDS—Alternate, covered with thick, pubescent scales. Terminal buds usually less than ⅓ of an inch long, flattened, ovate, blunt-pointed. Lateral buds usually less than 1/6 of an inch long, obtuse at apex, often superposed.

LEAVES—Alternate, compound with 13-23 leaflets. Leaflets 3-4 inches long, oblique at base, acute at apex, serrate on margin, almost sessile and arranged opposite or alternate to each other.

LEAF-SCARS—Alternate, large, 3-lobed, often heart-shaped, raised; upper margin notched in which an axillary bud is often located. Bundle-scars grouped in three clusters, arranged in a U-shaped line.

FLOWERS—Appear in May when the leaves are about half-developed. Staminate and pistillate flowers are separate, but occur on same tree and usually on same branch. Staminate arranged in unbranched catkins. Pistillate produced in 2-5 flowered spikes.

FRUIT—A sculptured nut with a fleshy indehiscent covering. Nut round, very rough, 1-2 inches in diameter, occurs solitary, in pairs, sometimes in 3s; contains an edible somewhat oily kernel.

WOOD—Diffuse porous with a ring-porous tendency; medullary rays inconspicuous; rich dark brown, very durable, hard, strong, splits easily, takes glue well. Weighs 38 lbs. per cubic foot. Used in furniture, interior finishings, musical instruments, automobiles, sewing machines, fire-arms.

DISTINGUISHING CHARACTERISTICS—The Black Walnut, also known as Walnut, somewhat resembles the Butternut or White Walnut but bears little resemblance to other trees. It may be distinguished from the Butternut by its light brown chambered pith, shorter and less flattened terminal buds, darker bark, larger size, more globose nut, notched upper margins of leaf-scars, and the absence of a hairy fringe above the leaf-scar.

RANGE—New England and New York to Minnesota, and south to Florida.

DISTRIBUTION IN PENNSYLVANIA—Local throughout the State in rich bottomlands and on fertile hillsides. Very rare in the northern part, where it is entirely absent over large areas.

HABITAT—Prefers rich moist soil. Requires plenty of light and deep soil since it is evidently tap-rooted. It does not thrive in the northern part of the State. It is generally absent throughout the cold Black Forest region of Pennsylvania. The Butternut extends farther northward and grows at higher altitudes.

IMPORTANCE OF THE SPECIES—The Black Walnut is one of the most valuable timber trees native to this State. It reaches a large size, is attractive ornamentally, and produces wood valuable for its color, figure, and the fine polish which it takes. The nuts are highly prized. Forest grown trees rarely produce much fruit. Open grown trees produce abundant fruit and often highly figured wood.

THE HICKORIES—CARYA, Nuttall

The Hickories and the Walnuts belong to the same family. All but one species of Hickory, so far as known, are native to the part of North America lying east of the Rocky Mountains. Geological records inform us that the ancient forests of hickory extended into Greenland and Europe. None of the fossil species shows evidence of living after the ice age. This suggests the presumption that the hickory forests were completely destroyed by sheets of ice advancing from the North towards the South. These sheets covered a large part of Europe and North America. To-day no native species of Hickory are found in Europe, showing that they were completely exterminated during the ice age. In North America the ice covered only a portion of the range of hickory. Hickory is found today not only in the nonglaciated region of North America but in addition it has regained some of the lost territory. The northern limit of Hickory is, however, still about 1,000 miles south of its northern limit in the ancient flora of Greenland. The range of some of the more important species of Hickory has been extended by man.

The Hickories have alternate, compound and odd-pinnate leaves. The leaf-scars are large and conspicuous. The flowers are unisexual. The staminate or male (pollen-bearing) flowers are produced in long slender, drooping aments. The aments are usually in 3s, united near the base of twig into a common stalk which is attached to the twig at the base of the new growth. The pistillate or female flowers which develop into the fruit occur at the end of the season's twigs in spike-like clusters of 2-6. The fruit resulting from the development of the pistillate flowers matures in one season. The nuts are ovoid to cylindrical and covered with a husk which is 4-valved. In most species the husk splits open at least to the middle when it becomes dry but in a few species it separates very little.

The Hickories are amongst our most important timber trees. They are not important because they produce a large quantity of wood but because they produce a special quality of wood used for special purposes for which no substitutes have been found. The wood is unsurpassed for such uses where strength combined with lightness is desired. It is largely used for handles and in the manufacture of our best carriages, especially in the construction of the wheels. Not all of the species, however, produce valuable wood. The wood of the Bitter Nut Hickory is relatively of little value. The nuts of a few species are edible. These nuts were used for food and for oil by the Indians and at the present time they are used extensively for food. The most valuable and edible nuts are obtained from the Shag-bark Hickory (Carya ovata).

The genus Carya comprises about 10 species found in eastern North America and 1 species in Mexico. Six species are native to this State. One species, the small-fruited Hickory (Carya microcarpa, Nutt.), sometimes considered a variety of the Pignut Hickory, is found locally in the State but not described in this publication. In addition to our native species the Pecan Hickory (Carya illinoensis) is planted extensively for ornamental purposes and for the sweet nuts which it produces.

SUMMER KEY TO THE HICKORIES

Page

1. Leaflets 7-11, small, lanceolate, usually curved, ...**C. cordiformis** 116
1. Leaflets 5-7, larger, broader than lanceolate, rarely curved, ...2

2. Husk of fruit splits tardily into 4 valves; valves of fruit thin and rather friable at maturity; twigs smooth, relatively slender, cherry-colored to gray, ...**C. glabra** 115
2. Husk of fruit splits promptly into 4 valves; valves of fruit thick and hard at maturity; twigs often hairy towards tip, rather stout, buff, gray, or brownish, ..3

3. Bark close, rough but not shaggy on old trunks; twigs relatively stout; foliage scurfy or pubescent, ...**C. alba** 114
3. Bark shaggy separating into long plates on old trunks; twigs not so stout; foliage smooth or sometimes downy beneath, ...4

4. Leaflets usually 7; nuts dull white or yellowish and pointed at both ends,..**C. laciniosa** 113
4. Leaflets usually 5; nuts white, rounded or notched at the base, ...**C. ovata** 112

WINTER KEY TO THE HICKORIES

1. Buds yellow with 4-6 bud-scales valvate in pairs; lateral buds often evidently-stalked; terminal buds elongated and flattened, ...**C. cordiformis** 116
1. Buds not yellow, truly scaly; bud-scales 10 or more usually overlapping, except outer ones on lateral buds which may form a closed sac but in time split from the top; inner scales hairy, ...2

2. Buds small; terminal buds 1/5 to 2/5 of an inch long, their outer scales glandular dotted; twigs smooth, relatively slender, cherry-colored to gray; husk of fruit thin, not freely splitting to base, with thin-shelled nut, ...**C. glabra** 115
2. Buds large; terminal buds 2/5 to 3-5 of an inch long, their outer scales almost glandless; twigs often hairy towards tip, rather stout, buff, gray, or brownish, husk of fruit thick, freely splitting to base, ...3

3. Twigs relatively stout; bark rough and close, not shaggy; nut brownish, thick-shelled, with small kernel; terminal buds broadly-ovate with their outer scales early deciduous, ...**C. alba** 114
3. Twigs not so stout; bark shaggy; nut white, dull-white, or yellowish with large kernel; terminal buds elongate-ovate with their outer scales tardily deciduous, ..4

4. Nuts dull white or yellowish and pointed at both ends, ...**C. laciniosa** 113
4. Nuts white, rounded or notched at the base, ...**C. ovata** 112

SHELL-BARK HICKORY

Carya ovata, (Miller) K. Koch

FORM—A large tree usually reaching a height of 50-75 ft. with a diameter of 2 ft. but may reach a height of 120 ft. with a diameter of 3-4 ft. Trunk straight, slender, in dense stands free from branches for the greater part of its length; in open grown trees short, with an oblong-cylindrical high crown.

BARK—On old trunks shaggy, light gray, 2/5-1 inch thick, peeling off in rough strips or plates which are usually loose at both ends and fastened in the middle. On young trunks smooth and light gray. See Fig. 107.

TWIGS—Intermediate in thickness between the Mocker Nut and the Pignut Hickory, usually slightly downy, sometimes smooth and glossy; reddish-brown to grayish, covered with numerous conspicuous and longitudinally-elongated lenticels; pith angular.

BUDS—Alternate, more than 2-ranked. Terminal bud broadly ovate, blunt-pointed, 2/5-4/5 of an inch long, usually covered by about 10 bud-scales. The 3-4 outer scales dark brown, broadly triangular, sharp-pointed, often hairy especially along margin, sometimes smooth, and often with the apex terminating in a long rigid point. Inner scales increase in size in spring, are tardily deciduous, yellowish-green or reddish, densely downy on outer surface and smooth within.

LEAVES—Alternate, 8-14 inches long, compound, with 5-7 leaflets. Leaflets differ in size; basal pair small, relatively short and widest near the base; upper pair obovate and larger than basal pair; terminal large and obovate. Leaflets serrate on margin, acute at apex, tapering or rounded at base, usually smooth but sometimes hairy on lower surface.

LEAF-SCARS—Alternate, more than 2-ranked, large, conspicuous, somewhat raised, heart-shaped or 3-lobed or inversely-triangular or sometimes elliptical, containing numerous conspicuous bundle-scars which are distributed irregularly or grouped in 3 clusters or arranged in a curved line.

FLOWERS—Appear about May when leaves are almost fully developed. Staminate and pistillate flowers occur separately. Staminate are hairy and arranged in aments which are clustered in 3s and 4-5 inches long. Pistillate rusty-woolly arranged in 2-5 large spikes.

FRUIT—Globular or depressed at apex, 1-2 inches long, with a thick husk which splits into four pieces completely to the base. Nut is white, oblong, somewhat flattened, ridged, barely tipped with a point, with thin shell and large sweet kernel.

WOOD—Ring-porous; pores of summer wood rather large, isolated, rather evenly distributed, not in groups or lines; medullary rays rather abundant but inconspicuous; conspicuous lines of wood parenchyma present. Wood very heavy, hard, strong, tough, elastic, close-grained, usually straight-grained, not durable in contact with soil. Heartwood light brown or reddish with white sapwood. Weighs from 50 to 52 lbs. per cubic foot. Used chiefly for handles and light vehicles. Valuable for fuel and smoking meat.

DISTINGUISHING CHARACTERISTICS—The Shell-bark Hickory, also known as Shag-bark Hickory, can be distinguished from the Bitter Nut Hickory by means of its larger many-scaled buds which are not flattened nor yellow, and by its bark which is shaggy, while that of the latter is close and rough. The bark of the Pignut Hickory, is also close and rough. The Pignut Hickory has scaly buds but they are much smaller than those of the Shell-bark Hickory. The fruit of both the Pignut Hickory and Bitter Nut Hickory is smaller and has a thin tardily or non-splitting husk and a smaller bitter kernel, and their leaves are smoother and their leaflets narrower than those of the Shell-bark Hickory. The Mocker Nut Hickory has stouter twigs, scurfier pubescent foliage, closer and rougher bark, and browner nuts with a small kernel. For distinguishing characteristics between Carya ovata and Carya laciniosa, see page 113.

RANGE—Quebec west to Minnesota and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Most common in the southeastern and southwestern parts of the State. Rare in the mountainous parts, except locally in the valleys. Rather abundant locally east of the Allegheny mountains especially in the fertile valleys and along the rich foothills. Reported rather abundant locally in the northern part.

HABITAT—Prefers rich moist soil and plenty of light. Common in the valley and in moist hillside woods. Also common along streams, and on the border of swamps.

IMPORTANCE OF THE SPECIES—This is a very important species on account of the valuable wood and nuts which it produces. It is not very common in the State as a whole, but where it does occur it should be protected and regenerated as much as possible. Seeds rather than seedlings should be planted because the latter are sensitive to transplanting on account of their long taproot.

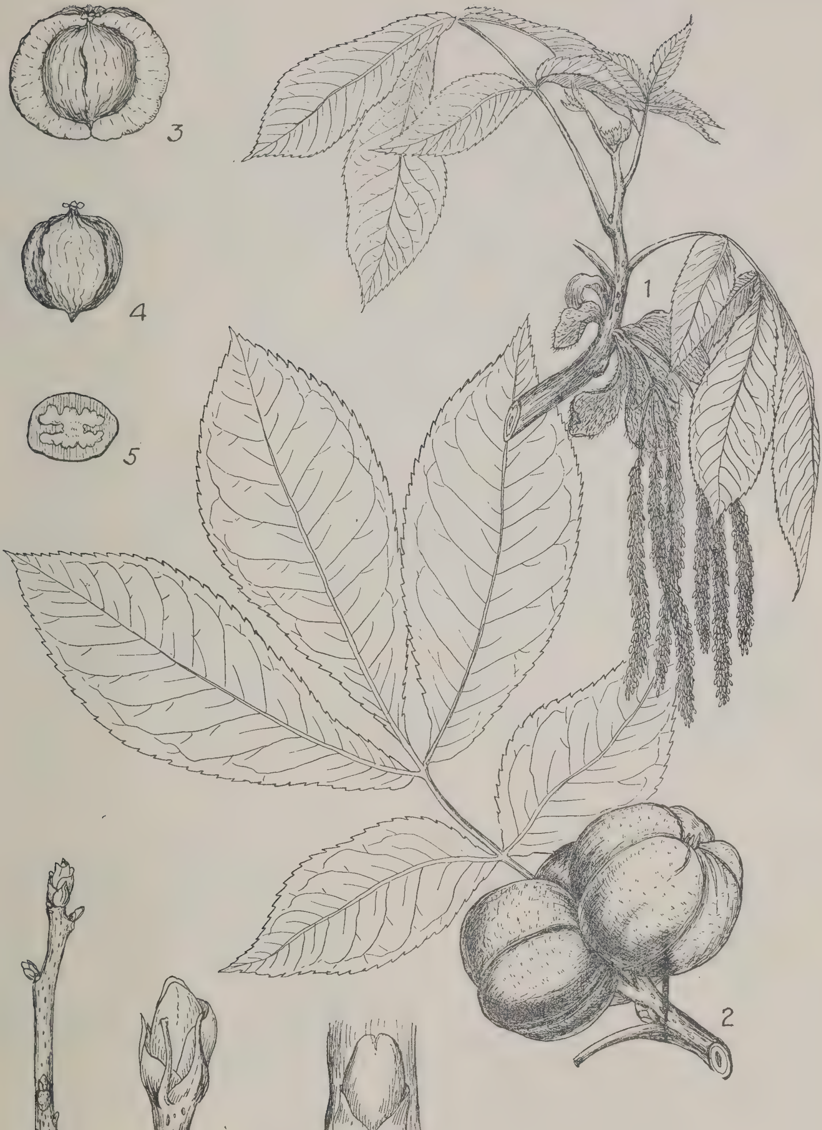

PLATE XXXVIII. SHELL-BARK HICKORY

1. A flowering branch, x ½.
2. A branch with fruit and a mature leaf, x ½.
3. A nut with part of husk removed, x ½.
4. A nut, x ½.
5. Cross-section of a nut showing kernel, x ½.
6. A winter twig, x ½.
7. Terminal part of a winter twig, natural size.
8. Section of a winter twig showing a lateral bud and leaf-scar, enlarged.

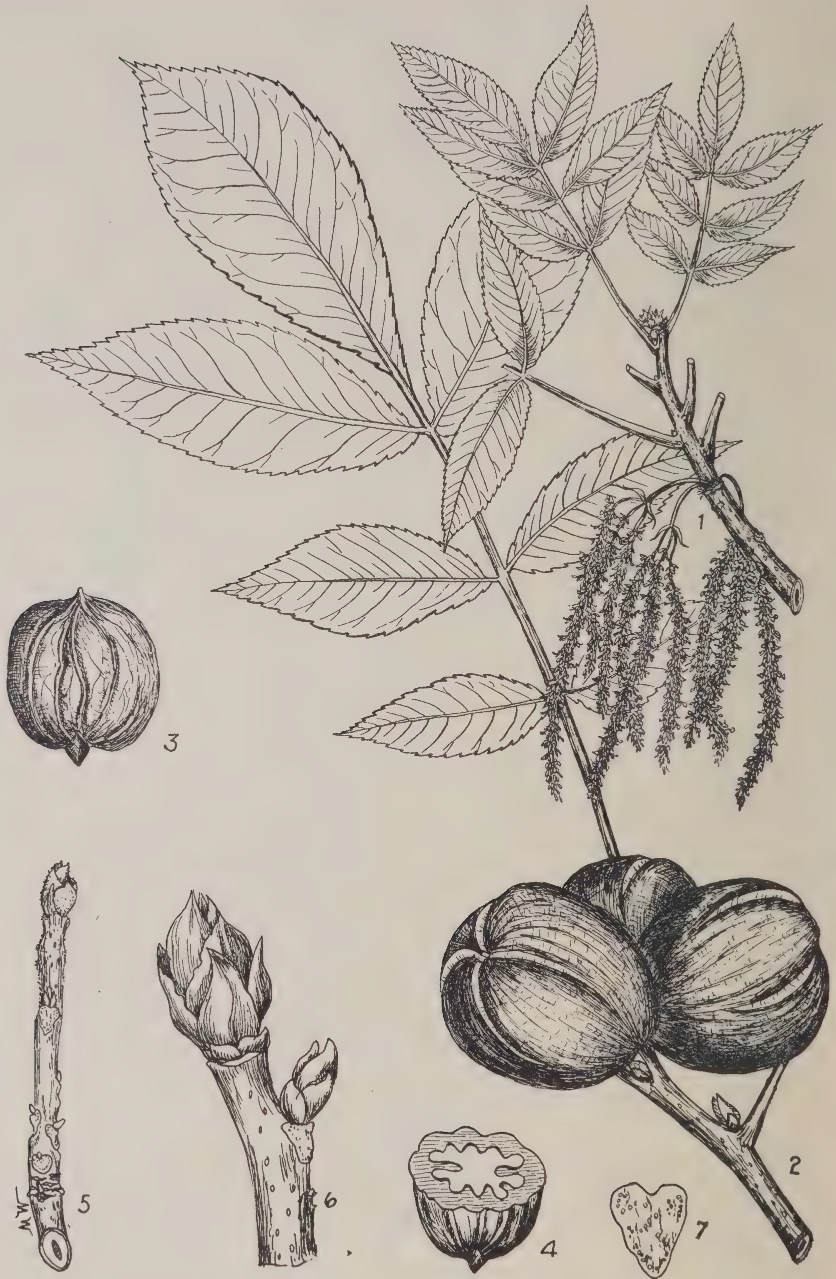

PLATE XXXIX. BIG SHELL-BARK HICKORY

1. A flowering branch, x ½.
2. A branch with fruit and a mature leaf, x ½.
3. A nut, x ½.
4. Cross-section of a nut, x ½.
5. A winter twig, x ½.
6. Terminal part of a winter twig, slightly enlarged.
7. A leaf-scar with bundle-scars, slightly enlarged.

BIG SHELL-BARK HICKORY

Carya laciniosa, (Michaux f.) Loudon

FORM—In general it is the same as the Shell-bark (Carya ovata) except that it does not attain so large a diameter. When grown in a dense forest its trunk is very long, clean, and slightly tapering.

BARK—Same as Shell-bark Hickory (Carya ovata) or probably somewhat less shaggy.

TWIGS—Stout, usually a little velvety or tomentose, buff to nearly orange in color, covered with numerous rather inconspicuous longitudinally-elongated lenticels; pith angular.

BUDS—Similar to those of the shell-bark (Carya ovata) except that they are a little larger and have less keeled and more hairy outer scales.

LEAVES—Alternate, compound, with 7-9 leaflets, 10-22 inches long. Leaflets differ in size; basal pair smallest, about ½ size of the terminal; the upper pair broadest between the middle and the apex. Leaflets sharp-pointed at apex, serrate on margin, tapering or rounded at base, thick, firm, dark green and smooth above, pale green to brownish and hairy below. Leaf-stalks grooved, stout, smooth or hairy, thickened at base, often persist for a long time.

LEAF-SCARS—Alternate, more than 2-ranked, large, conspicuous, somewhat raised, heart-shaped or 3-lobed or inversely triangular or sometimes elliptical, containing numerous conspicuous bundle-scars which are distributed irregularly, grouped in 3 clusters or arranged in a curved line.

FLOWERS—Similar to those of Shell-bark Hickory (Carya ovata). See page 112.

FRUIT—Ovoid or broadly-oblong, 4-ribbed above the middle, covered with very thick husk which splits readily to the base. Nut dull white or yellowish, thick-walled, usually strongly pointed at both ends, containing a sweet, light brown and deeply lobed kernel.

WOOD—Similar to that of the Shell-bark (Carya ovata), see page 112. Lumbermen do not and manufacturers cannot distinguish between the wood of the two species.

DISTINGUISHING CHARACTERISTICS—The Big Shell-bark Hickory, also known as Shag-bark Hickory and King Nut, is most closely related to the Shell-bark Hickory (Carya ovata). It can best be distinguished by its dull white or yellowish nuts which are usually strongly pointed at both ends, while those of the latter are white and barely tipped with a point and often rounded or notched at the base. The leaflets of this species number 7-9 to a leaf and are more downy on the lower surface than in Carya ovata which has only 5-7 leaflets to each leaf. For distinguishing characteristics between this species and other Hickories see "Distinguishing Characteristics" under Carya ovata, page 112.

RANGE—Central New York and Pennsylvania, west to Iowa and Nebraska and south to Tennessee and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Common in the southeastern part of the State. Most common east of the Allegheny mountains. Rare in the mountainous region except locally in the fertile valley between the mountains. Locally present in the western part. Probably most common in Northampton, Bucks, and Montgomery counties.

HABITAT—Prefers wet, rich soil. Often found on situations which are temporarily flooded in spring. Frequent in rich bottomlands and on fertile hillsides.

IMPORTANCE OF THE SPECIES—This is a very important tree on account of the valuable wood and nuts which it produces. It is not very common in the State as a whole, but where it does occur it should be protected and regenerated as much as possible. Seeds should be planted rather than seedlings because the latter are sensitive to transplanting on account of their long taproot.

MOCKER NUT HICKORY

Cary alba, (Linnaeus) K. Koch

FORM—A large tree usually 50-75 ft. high with a diameter of about 2 ft. but may reach a height of 90 ft. with a diameter of 3 ft. Crown narrow oblong to broad round-topped. Trunk often swollen at base, in dense stands straight, clean, with little taper and free from branches for one-half of its height.

BARK—Dark or light gray, ½-¾ of an inch thick, close, not shaggy nor smooth, roughened by irregular furrows which separate broad, flat, close, more or less scaly and rounded ridges. See Fig. 109.

TWIGS—Compared with the other Hickories very stout, usually decidedly downy, reddish-brown, covered with numerous pale and longitudinally-elongated lenticels; pith angular.

BUDS—Alternate, more than 2-ranked. Terminal bud very large, ovate, 2/5-4/5 of an inch long, densely hairy, usually blunt-pointed, covered with overlapping scales, the outer pair of which drops off in autumn and exposes the inner yellowish-gray silky scales. Lateral buds reddish-brown and do not split open very early.

LEAVES—Alternate, 8-12 inches long, compounded with 7-9 leaflets. Leaflets lanceolate-obovate, sharp-pointed at apex, toothed on margin, rounded or tapering at base, very fragrant, often downy on lower surface. Leaf-stalks hairy, flattened, grooved, and enlarged at base. Upper pair of leaflets largest, with greatest width between the middle and the apex; lower pair often oblong-lanceolate.

LEAF-SCARS—Similar to those of Shell-bark Hickory (Carya ovata).

FLOWERS—Appear about May when the leaves are half developed. Staminate and pistillate flowers occur separate. Staminate borne in slender catkins 4-5 inches long, which are clustered in 3s on a common stalk. Pistillate borne in 2-5-flowered pale hairy spikes.

FRUIT—Globular or ovoid, 1½-2½ inches long, with a very thick or hard husk which splits to the middle or base. Nut globular, brownish, not evidently-flattened but 4-ridged towards apex, with a very thick shell and comparatively small and sweet kernel.

WOOD—Similar to that of the Shellbark Hickory (Carya ovata). See description, page 112. Has a somewhat wider sapwood which is very white in color whence its specific name—alba. Heartwood dark brown.

DISTINGUISHING CHARACTERISTICS—The Mocker Nut Hickory, also known as the Bull Nut Hickory, the Big Bud Hickory, and the White-heart Hickory, can be distinguished from the two Shell-bark Hickories by its bark, which is rough and close-fitting and does not shag off, its stouter twigs, its scurfy pubescent foliage and its globular fruit which contains a globular brownish thick-shelled nut with a relatively small kernel. The buds are somewhat larger than those of the Shell-bark Hickories and thicker than the Pignut and Bitter Nut. The kernel of the latter two species is bitter and their leaflets are narrower and smoother.

RANGE—Massachusetts and Ontario, west to Nebraska, and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found most commonly in the rich valleys in the eastern and southern parts of the State with local outposts in the central part. Also found in the hardwood forest region in the western part.

HABITAT—Prefers rich, moist woods. Requires considerable moisture and sunlight. Does not thrive in shaded situations. Found mainly in valleys and in fertile situations at the bottom of slopes.

IMPORTANCE OF THE SPECIES—The Mocker Nut Hickory produces as valuable a wood as any of the Hickories. Some think that the wood is better than that produced by our other native Hickories because of the large amount of white sapwood. It is difficult to transplant on account of its long taproot, hence it is advisable to plant the seeds rather than seedlings. Every effort which one puts forth in developing and perpetuating this tree in our forests, especially in the farmer's woodlot, is justified. The fruit is large but the kernel is small and as a consequence it has no special market value.

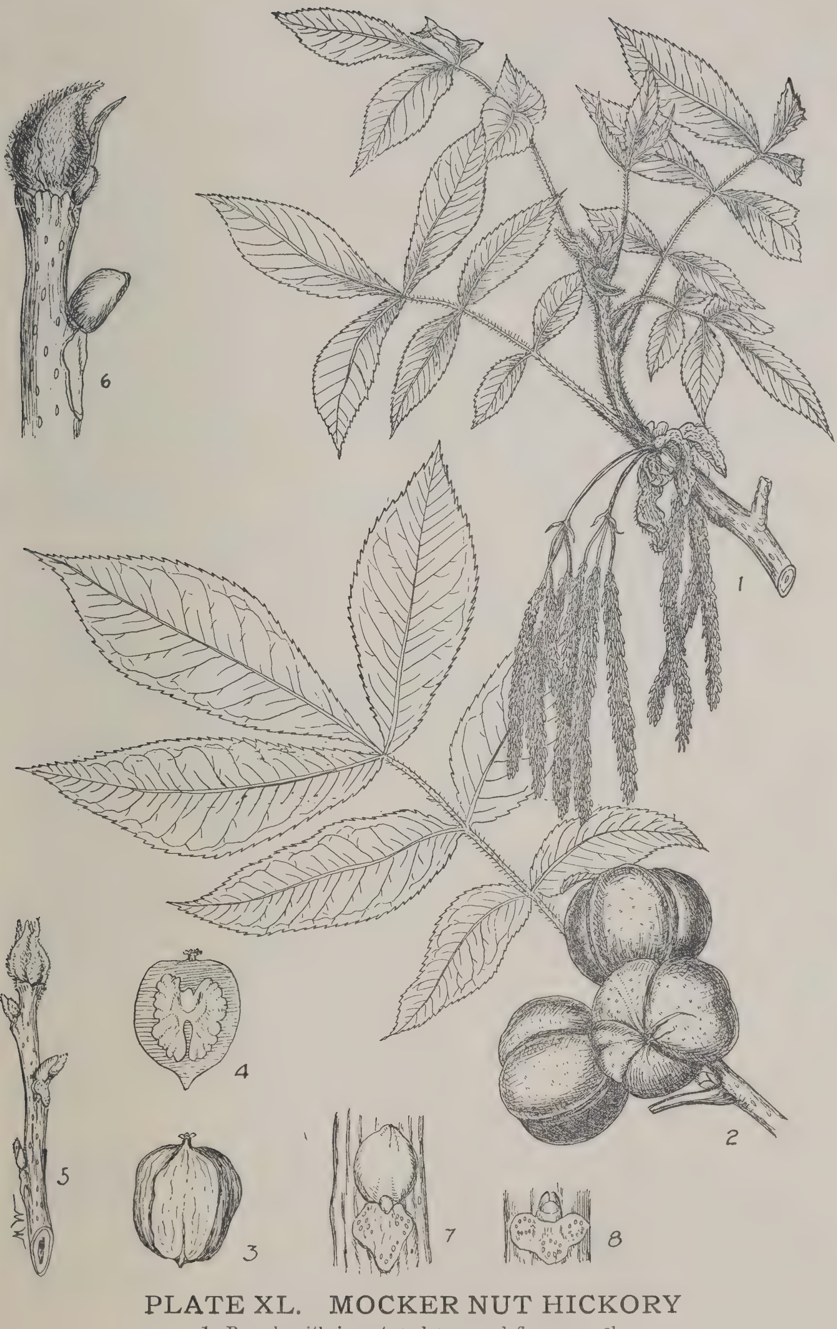

PLATE XL. MOCKER NUT HICKORY

1. Branch with immature leaves and flowers, x ½.
2. Branch with a mature leaf and fruit, x ½.
3. A nut with husk removed, x ½.
4. Longitudinal section of a nut, x ½.
5. A winter branchlet, x ½.
6. A winter branchlet, slightly enlarged.
7. Section of winter branch, enlarged.
8. Section of winter branch, enlarged.

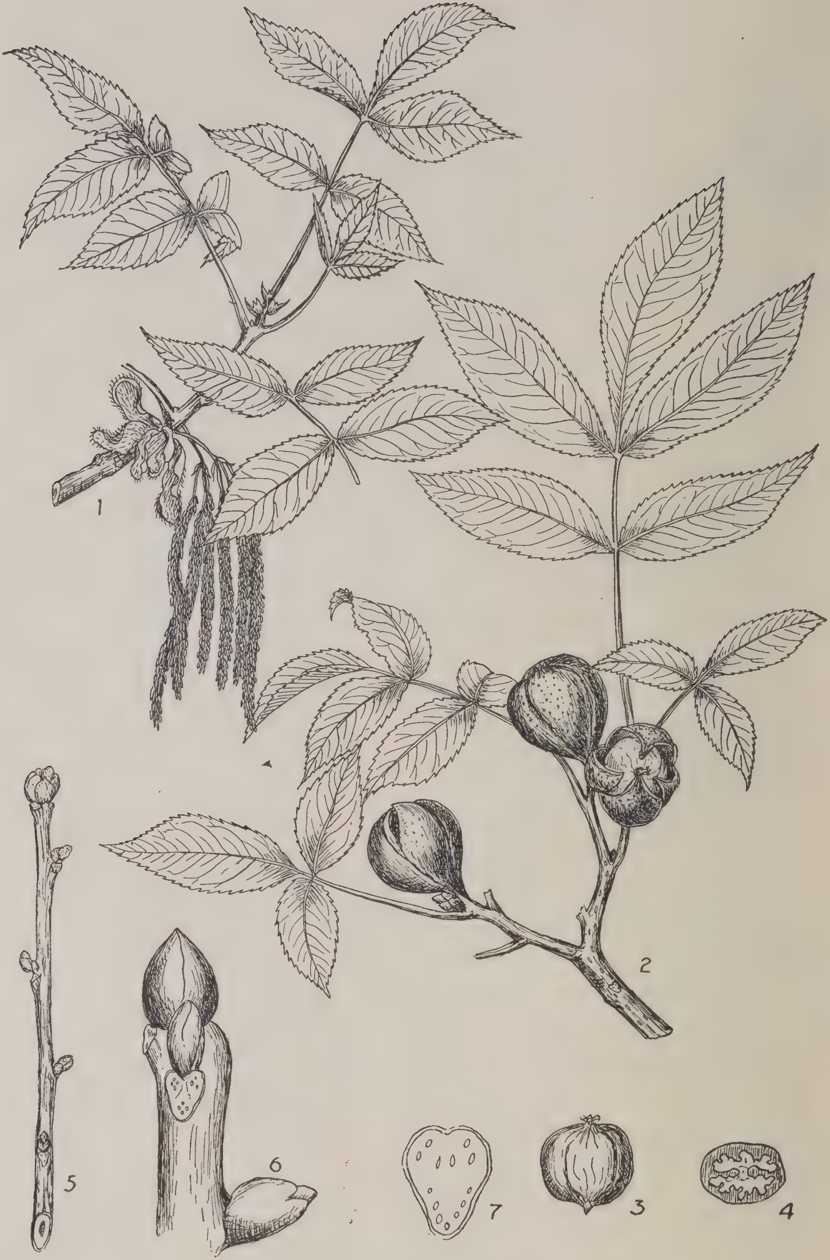

PLATE XLI. PIGNUT HICKORY

1. Branch with immature leaves and flowers, x ½.
2. Branch with mature leaves and fruit with husk partly removed, x ½.
3. A nut with husk removed, x ½.
4. Cross-section of a nut, x ½.
5. A winter branch, x ½.
6. Terminal section of a winter branch, enlarged.
7. A leaf-scar with bundle-scars, enlarged.

PIGNUT HICKORY

Carya glabra, (Miller) Spach

FORM—A fair-sized tree usually 50-60 ft. in height with a diameter of 2-3 ft., but may reach a height of 90 ft. with a diameter of 3-4 ft. Trunk slender, slightly-tapering, often clean and long. Crown oblong in shape, rather narrow, sometimes high, formed by short, spreading branches, the lower ones often drooping.

BARK—Rarely peels off or exfoliates, is close, dark gray, shallow-fissured, narrowly ridged, tough, ½-¾ of an inch thick. Resembles the bark of the White Ash. See Fig. 108.

TWIGS—Rather slender, usually smooth, at first yellowish-green, later reddish-brown, covered with numerous pale longitudinally-elongated lenticels, roughened by leaf scars and bud-scale scars; pith angular.

BUDS—Alternate, more than 2-ranked, reddish-brown to gray, oval, blunt-pointed. Terminal bud ¼-½ of an inch long, larger than the laterals. All buds covered with reddish-brown, smooth, sharp-pointed, somewhat keeled outer scales and pale-silky inner scales. Outer scales often drop off during winter.

LEAVES—Alternate, compound, with 5-7 leaflets, 8-12 inches long. Leaflets oblong to obovate-lanceolate, sharp-pointed at apex, finely toothed on margin, tapering or obliquely rounded at base, thick, smooth, dark green above, paler below.

LEAF-SCARS—Alternate, heart-shaped or oblong or inversely triangular or 3-lobed, containing numerous prominent bundle-scars irregularly scattered or arranged in a curved line or in 3 clusters.

FLOWERS—Appear about May when leaves are about half developed. Staminate and pistillate flowers occur separately. Staminate arranged in aments about 3-5 inches long and clustered in 3s on a common stalk. Pistillate occur in 2-5-flowered spikes on the new growth.

FRUIT—Matures about October, variable in shape and size, pear-shaped or spherical to obovoid, 1-2 inches long, tapering at the base, reddish-brown, sometimes pubescent. Husk may remain closed or split open from apex towards the middle or occasionally along the entire length. Nut oblong to oval, with thick bony shell containing a kernel which is at first sweet, later bitter.

WOOD—Similar to that of the other Hickories of the State, except the Bitter Nut Hickory. See description of wood, page 112.

DISTINGUISHING CHARACTERISTICS—The Pignut or Broom Hickory, also known as the Bitter Nut Hickory, can be distinguished by its smooth and rather slender twigs which bear small oval reddish-brown buds covered with scales, the outer pair of which is smooth or glandular dotted and often falls off before spring, thus exposing the inner velvety scales. Its buds are not yellow like these of the Bitter Nut Hickory and are smaller than those of our other native Hickories. The pear-shaped to ovoid fruit, with a thick bony-shelled nut is characteristic. The bark is close and does not exfoliate like that of the Shag-bark Hickory. The leaves, with 5-7 usually smooth and oblong to obovate-lanceolate leaflets, are distinctive.

RANGE—Maine and Ontario west to Minnesota and Nebraska, and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common in the southeastern and southwestern parts. Also found locally in other parts. More common in the mountainous portion of the State than any other Hickory.

HABITAT—Most common on dry ridges and hillsides. Rarer in swampy situations. Commonly scattered amidst our Oaks and Chestnut. Prefers plenty of sunlight.

IMPORTANCE OF THE SPECIES—The Pignut Hickory produces a very valuable wood, especially for the farmer. The fruit is not edible. It should be grown in the farmer's woodlot and in our larger forests in mixture with other forest trees. The seedlings are difficult to transplant on account of their long taproots, which are rather sensitive to handling. In attempting to grow this tree one should plant the nuts and not the seedlings. The great value of its wood justifies every effort that one can put forth in growing it.

BITTER NUT HICKORY

Carya cordiformis, (Wangenheim) K. Koch

FORM—A rather large tree usually 50-75 ft. high with a diameter of 1-2 ft. but may reach a height of 100 ft. with a diameter of 2½-3 feet. Trunk long, clean, with little taper. Crown round-topped, broadest near top, rather shallow in forest grown specimens. Lateral branches stout and ascending, often with semi-pendulous branchlets.

BARK—Light gray, rather thin, roughened by shallow fissures and narrow ridges; tight-fitting and does not peel off or shag off in loose scales like the Shag-bark Hickory. See Fig 110.

TWIGS—Slender, smooth, glossy, often yellow-glandular and hairy towards apex, grayish or orange-brown or reddish, roughened with numerous pale and longitudinally-elongated lenticels; pith brown and angular.

BUDS—Alternate, covered by 4 yellowish, glandular-dotted scales occurring in valvate pairs. Terminal bud evidently-elongated, flattened, blunt-pointed. Lateral buds usually superposed; the lowest or axillary one usually small and sharp-pointed; the upper one larger, evidently-stalked and angular.

LEAVES—Alternate, 6-10 inches long, compound, with 7-11 leaflets. Leaflets lanceolate to ovate-lanceolate, lateral ones sessile, sharp-pointed at apex, finely toothed on margin, obliquely tapering or heart-shaped at base; when mature dark yellowish-green above, paler below.

LEAF-SCARS—Alternate, large, conspicuous, raised, heart-shaped, triangular to elliptical, lighter than twigs, containing numerous bundle-scars arranged in 3 groups or in a single curved line or occasionally scattered irregularly over whole scar.

FLOWERS—Appear about May when leaves are half-developed. Staminate and pistillate flowers occur separate. Staminate are green and arranged in triple-clustered aments about 3-4 inches long. Pistillate grouped in small clusters on the new growth about ½ of an inch long, somewhat angled and scurfy-hairy.

FRUIT—Matures about October; spherical to obovate, about ¾-1½ inches long. Husk thin, yellowish glandular-dotted, splits open to about the middle into four valves; before splitting appears 4-winged from apex to about the middle. Nut thin-shelled, at least as broad as long, smooth, short-pointed, with reddish-brown and very bitter kernel.

WOOD—Wood resembles that of the other Hickories, described on page 112, only it is somewhat lighter, not quite so strong, of somewhat less fuel value, more brittle, less stiff, and yields more ash when burned.

DISTINGUISHING CHARACTERISTICS—The Bitter Nut Hickory, also known as Tight Bark Hickory, Swamp Hickory and Bitter Hickory, can be distinguished by its lanceolate leaflets which are pubescent beneath, and smaller than those of any other native Hickory. It is the only native species which has yellow buds with 4-6 bud-scales arranged in valvate pairs. Its terminal buds are flattened and elongated while the lateral buds are evidently-stalked and superposed. The nut is globular, short-pointed, thin-walled, containing a bitter kernel, and is covered by a thin husk which in time splits open from the apex to about the middle. The bark is rough, but does not scale off, which characteristic it has in common with the Pignut and the Mocker Nut.

RANGE—Quebec to Minnesota and Nebraska and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Local throughout the eastern and southern parts. Common in the southwestern part, where it attains a large size. Also reported from the central and northern parts. In the northern part it is rare. It follows the streams and valleys northwards as far as it can withstand the cold. Beyond this it is occasionally found on the mountain tops above the severe frost line. Usually solitary and scattered.

HABITAT—Prefers low, wet, and fertile situations such as border of streams and farmers' woodlots located in rich agricultural regions. Often found, however, far up the slopes of mountains. It ascends almost to the top of the South Mountain in Pennsylvania. Not very tolerant of shade.

IMPORTANCE OF THE SPECIES—The Bitter Nut Hickory produces valuable wood but its fruit is not edible. It grows best on rich moist soil such as one usually finds in a farmer's woodlot. It endures transplanting better and grows more rapidly than any other of our Hickories. This valuable tree is becoming rare. A future supply of wood should be insured by developing this tree in mixture with others in the farmers' woodlots and in fertile portions of larger forests. It is not gregarious but prefers to grow as a single specimen in mixture with other trees.

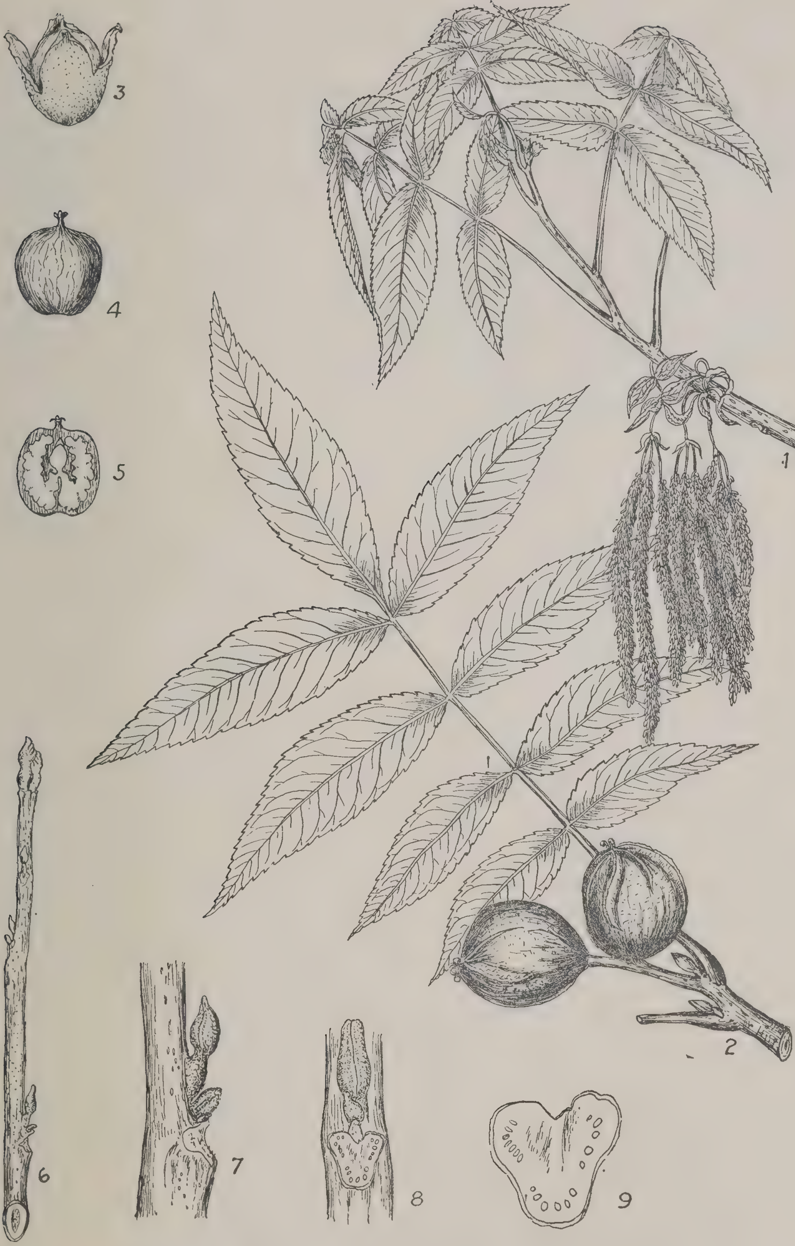

PLATE XLII. BITTER NUT HICKORY

1. Branch with immature leaves and flowers, x ½.
2. Branch with a mature leaf and fruit, x ½.
3. A fruit with husk partly opened, x ½.
4. A nut with husk removed, x ½.
5. Longitudinal section of nut, x ½.
6. A winter branch, x ½.
7. Section of winter branch showing superposed buds, slightly enlarged.
8. Section of winter branch showing superposed buds and leaf-scar, slightly enlarged.
9. A leaf-scar with bundle-scars, enlarged.

THE BIRCH FAMILY—BETULACEAE

The Birch family comprises 6 genera with about 75 species of trees and shrubs which are confined to the colder part of the northern hemisphere. Of this number 5 genera with about 30 species are native to North America and 5 genera with 11 species to Pennsylvania.

All the members of this family, even though they may belong to different genera, have many morphological features in common. The leaves are simple, alternate, borne singly or in pairs on the branches but never opposite each other. The staminate and pistillate flowers are separate, but are borne on different parts of the same tree and usually on different parts of the same branch. The staminate flowers are long, usually in drooping aments, or in spike-like or knob-like aments and may be with or without a perianth. The fruits are small, one-celled, usually subtended by a large bract which in the most important genera develops into a cone-like structure called a strobile.

Various products of high commercial importance are produced by this family. The wood of the Birches is used extensively for furniture, flooring, interior finishing and has a very high fuel value. The fruit of the Hazelnuts is prized as food. The wood of some of the Alders is especially adapted to the manufacture of gunpowder and charcoal. The bark of the Black Birch yields a volatile oil of considerable importance. The technical value of the products derived from the members of this family is becoming more important every year. The wood of some of the species which was despised formerly, is now considered of high value in some particular industries, on account of the new uses to which it is being put. The science of Wood Technology, which is merely in its formative period, will do much in advancing the position of the wood of species at present despised or at least not fully known. The subjoined key will aid in distinguishing the genera of this family.

KEY TO THE GENERA.

Page

1. Staminate flowers solitary on each bract; pistillate flowers with a perianth; fruit not a strobile, ... 2
1. Staminate flowers 2 to several on each bract; pistillate flowers without a perianth; fruit a strobile, ... 4

2. Shrubs; twigs covered with stiff red hairs standing out at right angles; nuts large covered by leaf-like involucre, ... Corylus 128
2. Trees; twigs not covered with stiff red hairs; nuts small and subtended by a large bract, ... 3

3. Bark close, smooth and fluted; nut subtended by a flat 3-lobed bract, terminal lobe serrate on one side, ... Carpinus 126
3. Bark thin covered by loose ribbon-like narrow brown scales; nut subtended by a closed bract arranged in hop-like clusters, ... Ostrya 125

4. Shrub with close, somewhat fluted bark; wood yellowish upon exposure; buds stalked, obtuse at apex, covered with two exposed valvate scales; fruit woody and persistent, ... Alnus 127
4. Small to large trees with loose bark usually peeling off into thin film-like layers; buds not stalked, acute at apex, covered with 3 or more overlapping scales; fruit membranous and deciduous, ... Betula 118

THE BIRCHES—BETULA, TOURNEFORT (L.).

The genus Betula comprises about 35 known species of which number 25 are trees and the others shrubs. About 15 are native to North America and 5 to Pennsylvania.

The members of this genus are without exception called Birches. In most of them the bark of the trees when young is smooth and peels off into film-like papery layers which vary in color according to the species from chalky white to reddish-brown. A few species have, however, a close and smooth bark which does not peel off into thin film-like papery layers. The wood is dense and hard, does not show the annual rings very clearly, is of high fuel value and usually reddish-brown in color, sometimes possessing a highly prized curly or wavy figure. The twigs of the season produce only one leaf at a point, while the twigs of the previous season produce two leaves from the lateral buds situate on the short spur-like branches. The leaves are simple, always alternate, occur singly or in pairs but never opposite. The flowers appear before or with the developing leaves. The staminate flowers appear clustered in long tassel-like bodies hanging down from the end of the twigs and are known as aments. The pistillate flowers appear below the staminate and are nearly erect, rather small and slender. The fruit is a cone-like structure known as a strobile, consisting of a central axis to which numerous scales are attached. The scales are thin, 3-lobed, and bear the small flat nuts with their wings. The nuts are very light and easily scattered by the wind for considerable distances from the mother or seed trees.

The commercial products derived from some of the Birches are rather important and valuable. Those found in the eastern part of North America yield products of more value than those found in the western part. Most of the birches found in the western part of North America are too small, or infrequent in the form of stands, to be commercially important for general or even domestic use. Some of those found in the eastern part of North America are also small shrubs but others reach the size of large timber trees which yield not only excellent wood but also valuable oils, flavors, and bark.

The subjoined key will aid in distinguishing the Birches found in Pennsylvania. Separate summer and winter keys were not developed since the following key is based primarily upon bark characteristics which are present at all seasons of the year.

KEY TO THE BIRCHES.

Page

1. Bark usually separating into thin film-like papery layers, ... 2
1. Bark close, not separating into thin film-like papery layers, ... 4

2. Outer bark white in color, ... B. alba var. papyrifera 120
2. Outer bark not white in color, ... 3

3. Outer bark yellow in color, strobiles usually sessile; leaves usually rounded at base, ... B. lutea 121
3. Outer bark reddish-brown, close, inner bark tinged with red; stobiles slender-stalked; leaves usually wedge-shaped at base, ... B. nigra 122

4. Bark chalky white covered with black triangular spots below insertion of lateral branches; small tree, often in clumps; leaves long-acuminate, ... B. populifolia 123
4. Bark dark reddish-brown; large tree, usually occurs singly; leaves ovate with acute apex; twigs and inner bark with wintergreen-like taste, ... B. lenta 124

PAPER BIRCH

Betula alba var. papyrifera, (Marshall) Spach

FORM—A large tree usually attaining a height of 50-75 ft. with a diameter of 1-2 ft., but may reach a height of 80 ft. with a diameter of 3 feet. Trunk in open grown trees short and covered nearly to the base with lateral, often ascending branches; in close stands branchless below and bearing a narrow open head.

BARK—On trunk and older branches chalky to creamy white and peeling off in thin film-like layers which are tinged with yellow and covered with horizontally-elongated lenticels. On older trunks rough and often fissured into irregular thick scales.

TWIGS—Rather stout, somewhat viscid, decidedly hairy, at first greenish, later becoming smooth, reddish-brown, and after several years, bright white, like the trunk, covered with pale, horizontally-elongated, orange-colored lenticels.

BUDS—Alternate, ovate, sharp-pointed, divergent, about ¼ of an inch long, dark chestnut-brown in color, covered by a few overlapping bud-scales with downy margins.

LEAVES—Alternate, simple, ovate, 2-3 inches long, 1½-2 inches wide, rather firm in texture; upper surface dark green, under surface light green; narrowed or rounded at the base, sharply toothed on the margin and sharp-pointed at the apex.

LEAF-SCARS—See "Leaf-Scars" under Black Birch, page 124.

FLOWERS—Appear in April or May before the leaves. The staminate are arranged in aments, which occur in groups of 2-3 and are about ¾ to 1½ inches long, becoming 3½-4 inches long in spring. The pistillate have light green lanceolate scales and bright red styles, and are arranged in clusters about 1-1¼ inches long.

FRUIT—A cylindrical, short-stalked strobile about 1½ inches long. Scales long, with thick lateral lobes and a rather long terminal lobe. Seeds are small and winged. Wings are wider than the nut.

WOOD—Diffuse-porous; rays small and inconspicuous; light, strong, hard, light brown tinged with red, with rather thick, light sapwood. Weighs 37 lbs. per cubic foot. Used extensively for spools, shoe lasts, pegs, fuel, and in the manufacture of paper pulp.

DISTINGUISHING CHARACTERISTICS—The Paper Birch, also known as Canoe Birch and White Birch, may readily be distinguished from all the other species of Birch in Pennsylvania except the Gray Birch, by its characteristic white bark which is never renewed when once removed. The European White Birch, which is introduced extensively for ornamental purposes, also has a white bark. To distinguish it from the Gray Birch see "Distinguishing Characteristics," page 123.

RANGE—From Newfoundland to Alaska, south to Pennsylvania, Michigan, Colorado, and Washington. This is one of the few transcontinental species.

DISTRIBUTION IN PENNSYLVANIA—Found only in the northern part of the State. Occurs locally in Cameron, Clinton, Lackawanna, Luzerne, Lycoming, Potter, Tioga, Union, Susquehanna, Wayne, and a few adjoining counties. Reported from Blair, Centre, and Huntingdon counties.

HABITAT—Usually found on rich wooded slopes and on the borders of lakes, swamps, and streams; also scattered through the forests of other hardwoods and occasionally through coniferous forests.

IMPORTANCE OF THE SPECIES—The Paper Birch is commercially of little importance in Pennsylvania on account of its limited distribution. It is not of sufficient importance to justify its artificial propagation, but wherever it occurs naturally it should be protected so as to insure an abundant future growth. The wood is sufficiently prized to justify its conservative utilization, and also its protection, where nature produces it gratuitously.

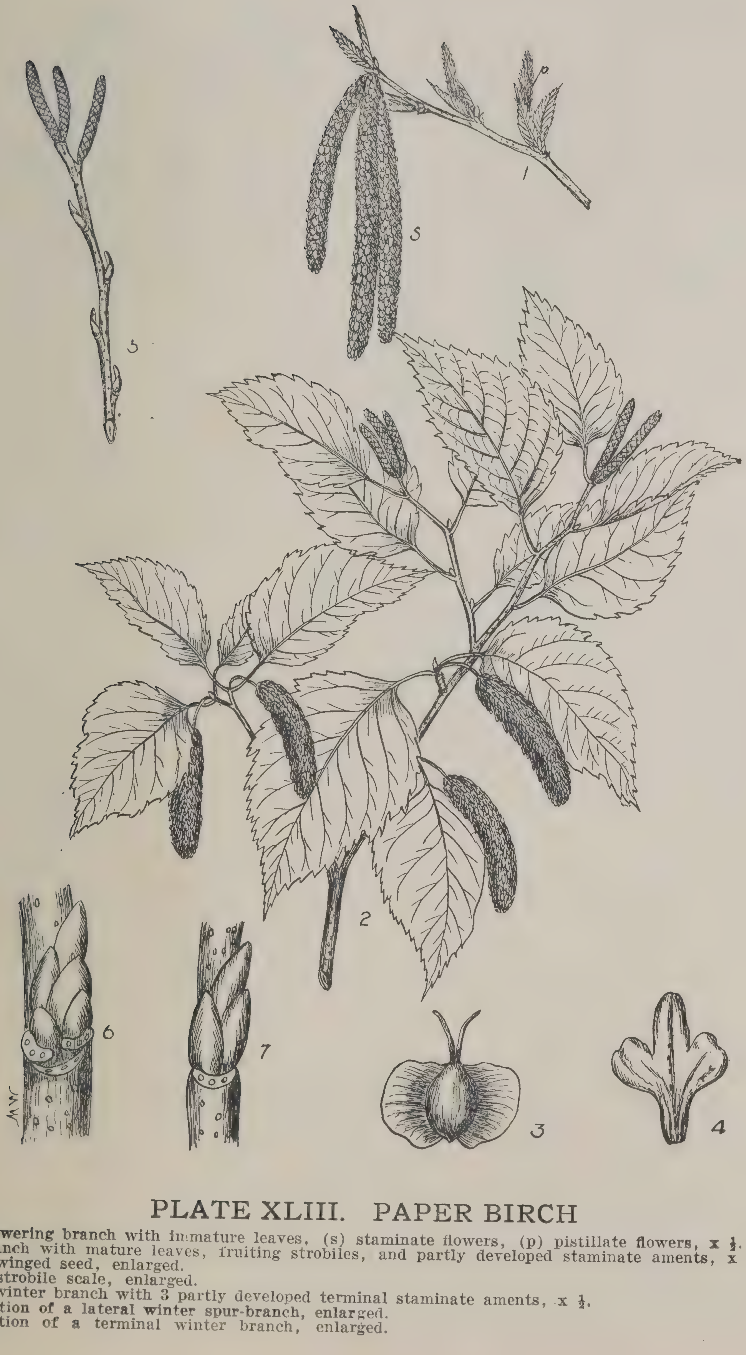

PLATE XLIII. PAPER BIRCH

1. Flowering branch with immature leaves, (s) staminate flowers, (p) pistillate flowers, x ½.
2. Branch with mature leaves, fruiting strobiles, and partly developed staminate aments, x ½.
3. A winged seed, enlarged.
4. A strobile scale, enlarged.
5. A winter branch with 3 partly developed terminal staminate aments, x ½.
6. Section of a lateral winter spur-branch, enlarged.
7. Section of a terminal winter branch, enlarged.

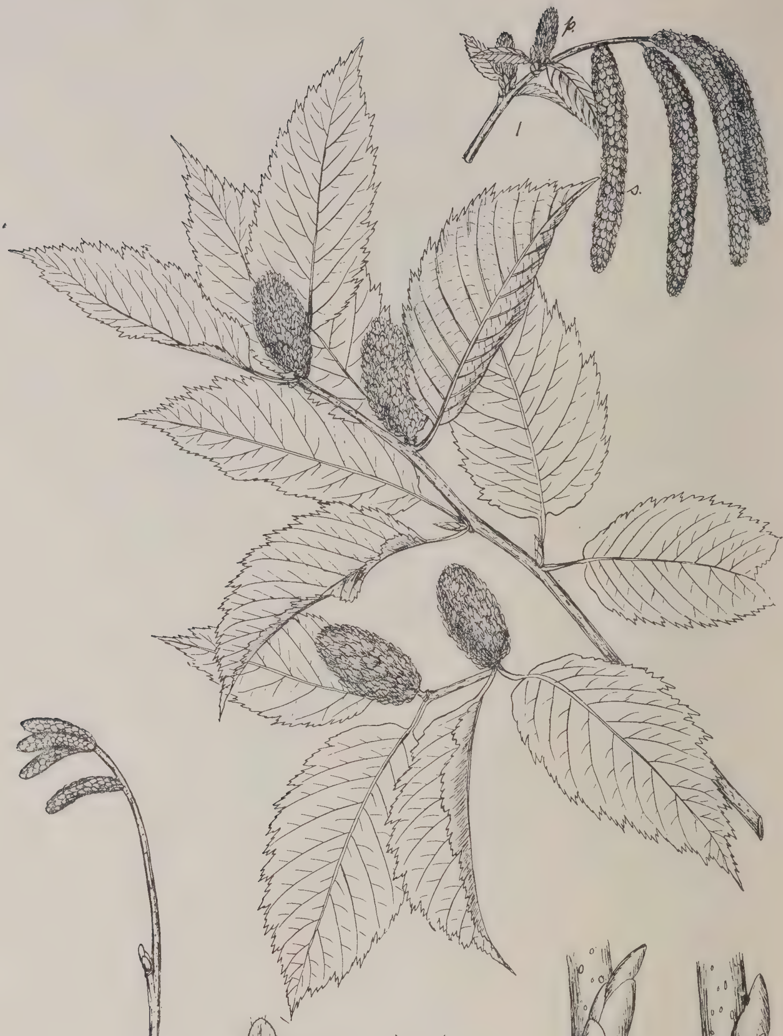

PLATE XLIV. YELLOW BIRCH

1. Flowering branch with (s) staminate flowers, and (p) pistillate flowers, x ½.
2. Branch with mature leaves and four fruiting strobiles, x ½.
3. A winged seed, enlarged.
4. A strobile scale, enlarged.
5. Winter branch with partly develeped terminal staminate aments, x ½.
6. Section of a lateral spur-like winter twig, enlarged.
7. Section of a terminal winter twig, enlarged.

YELLOW BIRCH

Betula lutea, Michaux

FORM—A large tree usually attaining a height of 60-80 ft. with a diameter of 2-3 ft., but may reach a maximum height of 100 ft., with a diameter of 3-4½ feet. Trunk in the open usually short, branching near the base; its long slender branches forming a wide open rather hemispherical crown, in close stands often rather free from lateral branches.

BARK—Close and furrowed or peeling off in thin yellow film-like papery scales. Varies with the age and location of the tree. On young trunks and branches rather close, shining, yellow but soon forming a ragged fringe, later peeling off into thin, yellow, film-like, papery layers. On old trunks it finally becomes reddish-brown and roughened with fissures. The ragged bark is often pulled off and used by campers to start fires in wet weather. See Fig. 87.

TWIGS—At first green and hairy, later brown and smooth, finally dull silvery-gray. Terminal twigs long and slender; lateral short and stout; usually covered with elongated horizontal lenticels which in time unite to form a long horizontal line.

BUDS—Similar to those of the Black Birch, but sometimes slightly more downy. See page 124.

LEAVES—Alternate, simple, occur singly or in pairs but never opposite, 3-4 inches long, ovate, wedge-shaped or heart-shaped at base, doubly serrate on margin, acute at apex, dull green above, yellowish-green below.

LEAF-SCARS—Similar to those of the Black Birch in particular, and all of the other Birches in general.

FLOWERS—Appear about April before the leaves. Staminate and pistillate separate, but usually on the same branch. Staminate formed in the fall, remaining over winter as aments about ¾ of an inch long which elongate to about 3 inches in spring. Pistillate about 2/3 of an inch long, with acute scales which are light red and hairy above, and green below.

FRUIT—An erect, usually very short-stalked strobile, about 1-1½ inches long, ovate in outline, consisting of numerous 3-lobed scales fastened to a central axis and bearing small winged nuts with rather narrow wings.

WOOD—Diffuse-porous; rays indistinct: heavy, hard, strong, compact, not durable when in contact with the soil. Heart-wood light brown, tinged with red; sap-wood pale. Weighs 41 pounds per cubic foot. Used for furniture, flooring, interior finish, boxes, veneers, hardwood distillation and fuel.

DISTINGUISHING CHARACTERISTICS—The Yellow Birch, also known as Silver and Gray Birch, can readily be distinguished from the other Birches of Pennsylvania by its yellow bark which peels off into thin, film-like, papery scales. In its method of peeling the bark resembles that of the Paper Birch and the Red Birch, but it does not have the white color of the former nor the reddish to greenish-brown color of the latter. The loose, film-like, papery scales of the Red Birch are smaller than those of the Yellow Birch and the strobiles of the former are slender-stalked while those of the latter are usually sessile or very short-stalked.

RANGE—Newfoundland, south to Pennsylvania, and along the mountains to North Carolina and Tennessee, west to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State but commonest in the Alleghenies. Rare or absent in the southeastern and southwestern parts. Small pure stands occur along some of the streams and on moist lower slopes in the northern part of the State.

HABITAT—Common on moist rich uplands, borders of streams, and in swamps.

IMPORTANCE OF THE SPECIES—The Yellow Birch is one of the largest deciduous trees of northeastern America. Until recently the value of its wood was not fully appreciated, but to-day it holds a fair position on the lumber market and in the future it will no doubt attain a still better position. It has been classed as one of the most artistic, reliable, and versatile of the hardwoods of this country. With all its good qualities, it has superior associates and consequently cannot be recommended for forestry purposes except in the farmer's woodlot where fuel is especially desired and in such other places where it comes up naturally and other more desirable trees will not grow to advantage.

RED BIRCH

Betula nigra, Linnaeus

FORM—A medium-sized tree usually attaining a height of 30-50 ft. with a diameter of 1-2 ft., but may reach a height of 100 ft. with a diameter of 5 feet. Trunk usually short and divided near the base into a few slightly divergent limbs. Crown rather narrow, oblong, and irregular. Largest Red Birch tree in the State stands along west branch of Susquehanna river near Avis in Clinton county.

BARK—Varies with the age of the tree and its location on the trunk. On lower part of old trunks dark reddish-brown and roughened by fissures which separate irregular scales. On younger trunks and upper portion of older ones peels off into thin, film-like, papery scales which are reddish-brown to greenish-brown in color and persist for a few years during which time they form a ragged fringe and expose the light red and close bark underneath. See Fig. 84.

TWIGS—Slender, at first hairy and greenish, later smooth, reddish-brown, covered by pale horizontally-elongated lenticels.

BUDS—Alternate, ovate, sharp-pointed, shining, smooth or slightly hairy, covered with usually 3-7 chestnut-brown overlapping scales.

LEAVES—Alternate, simple, broadly ovate, 1½-3 inches long, wedge-shaped at base, acute at apex, doubly serrate on margin, deep green above, pale yellowish-green below.

LEAF-SCARS—Similar to those of the Black Birch. See page 124.

FLOWERS—Appear about April before the leaves. Staminate and pistillate are separate, but usually occur on the same branch. Staminate formed in the fall, remaining over winter as aments about ¾ of an inch long, usually in clusters of three, which elongate to about 2-3 inches the following spring. Pistillate are about ⅓ of an inch long, developing in spring from buds situate below the staminate flowers.

FRUIT—An erect, slender-stalked, pubescent, cylindrical strobile, 1-1½ inches long, consisting of numerous 3-lobed pubescent scales fastened to central axis and bearing small, hairy, winged nuts. Terminal lobe of the scales is larger than the laterals.

WOOD—Diffuse-porous; rays indistinct; light, soft, strong, with light-brown heartwood and pale thin sapwood. Weighs 36 pounds per cubic foot. Used in the manufacture of furniture, slack-cooperage, fruit and vegetable baskets, woodenware and turnery.

DISTINGUISHING CHARACTERISTICS—The Red Birch, also known as the River Birch, can be recognized by its reddish-brown to cinnamon-red bark which peels off into film-like papery scales. The layers are smaller and less ragged than those of the Yellow Birch which has a decidedly yellow or silvery-yellow colored bark. The Black Birch has a closer bark which does not peel off and the other species of Pennsylvania have a white bark. The River Birch is usually found along streams or in other wet locations which may also aid in distinguishing it.

RANGE—Massachusetts south to Florida, west to Minnesota, Kansas, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State along the banks of the principal rivers and their chief tributaries, but rare in the western part. Abundant along the Delaware, Lehigh, Schuylkill, and Susquehanna rivers and their main tributaries. Reported from Westmoreland county in the western part of the State.

HABITAT—Prefers the banks of streams, lakes, pools, and swamps. Occasionally found upon drier locations. It is called River Birch because it is usually found along the banks of rivers or other locations having similar moisture conditions.

IMPORTANCE OF THE SPECIES—The Red Birch is of little commercial importance in Pennsylvania as a lumber tree on account of the relatively small size which it attains, the softness of its wood, and the absence of figure and attractive color in the wood as well as its limited distribution. It is essentially a southern tree reaching its best development in North Carolina and adjoining states. While it is of little commercial importance it may be of economic importance in such situations where moisture-loving trees are required to bind soil, as along streams, or where it is desirable to establish stands in extremely swampy locations. It is attractive as an ornamental tree.

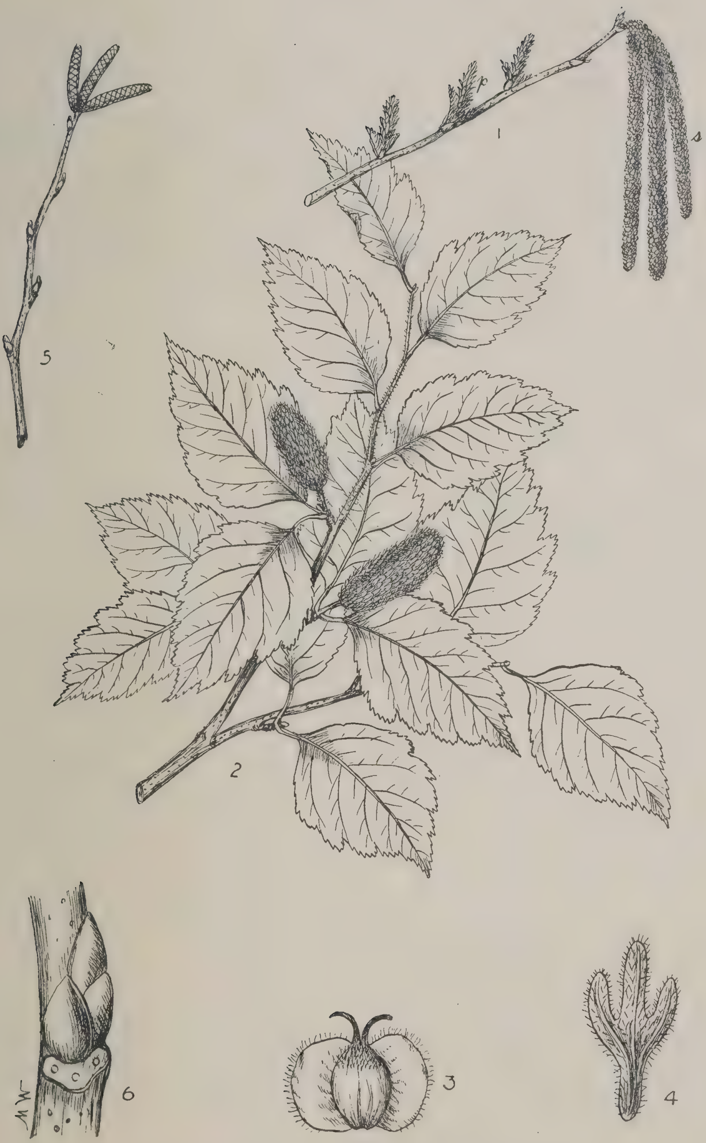

PLATE XLV. RED BIRCH

1. Flowering branch with (s) staminate flowers, (p) pistillate flowers), x ½.
2. Branch with mature leaves and two fruiting strobiles, x ½.
3. A winged seed, enlarged.
4. A strobile scale, enlarged.
5. A winter branch with three partly developed terminal staminate aments, x ½.
6. Section of a winter branch, enlarged.

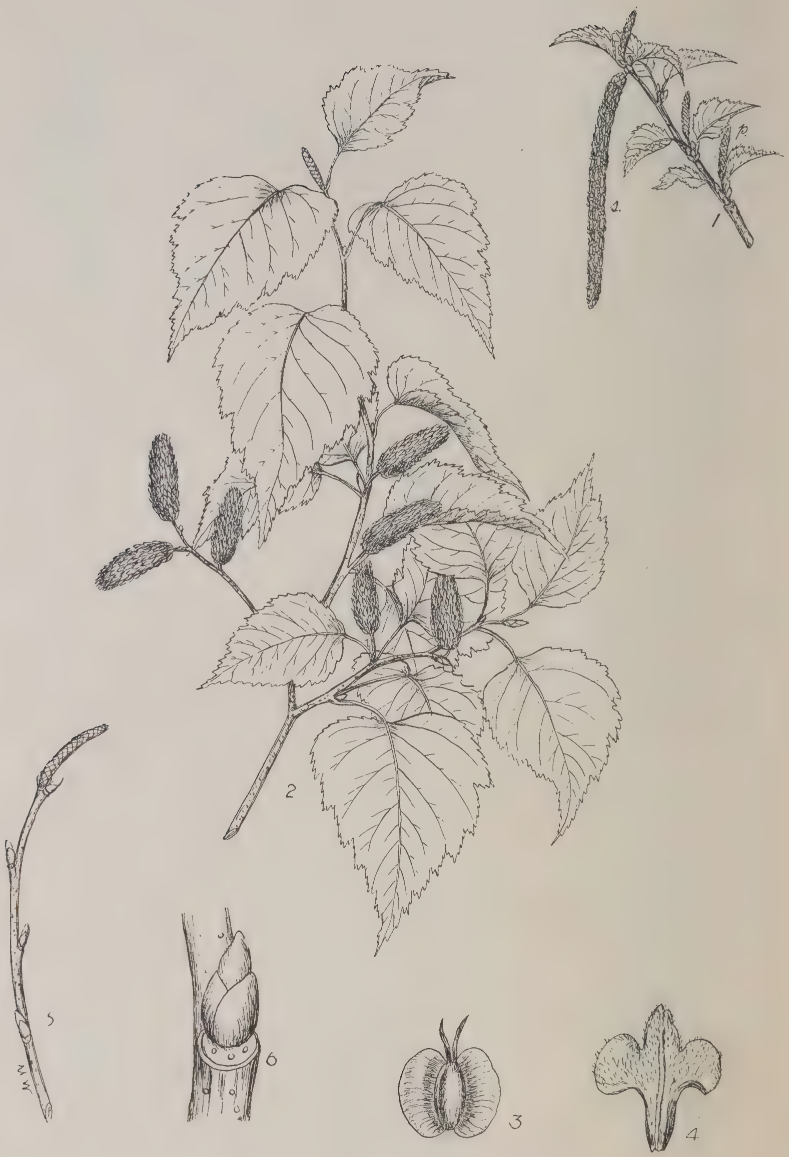

PLATE XLVI. GRAY BIRCH

1. Flowering branch with immature leaves (s) staminate flowers, (p) pistillate flowers, x $\frac{1}{2}$.
2. Branch with mature leaves and fruiting strobiles, x $\frac{1}{2}$.
3. A winged seed, enlarged.
4. A strobile scale, enlarged.
5. A winter branch with a partly developed terminal staminate ament, x $\frac{1}{2}$.
6. Section of a winter twig, enlarged.

GRAY BIRCH

Betula populifolia, Marshall

FORM—A small tree usually occurring in clumps and attaining a height of 20-30 ft. with a diameter of 9 inches, but may reach a height of 45 ft. and a diameter of 18 inches. Trunk slender, often inclined, continuous, and covered with ascending lateral branches with drooping ends which form a narrow pyramidal, rather open, and pointed crown.

BARK—Dull white, close, smooth not peeling off into thin film-like layers but covered with triangular black spots below the insertion of the lateral branches. On old trunks black and roughened with fissures. Inner bark orange-yellow. See Figs. 83 and 88.

TWIGS—Slender, greenish to brown, roughened by warty projections and by raised, pale, and horizontally-elongated lenticels; later smooth and dull white.

BUDS—Alternate, 2-ranked, ovate, 1/5 of an inch long, sharp-pointed, divergent, covered with 3-4 visible, smooth, slightly resinous, brown bud-scales with downy margins.

LEAVES—Alternate, simple, triangular, ovate, 2½-3 inches long, 1½-2 inches wide, wedge-shaped at base, decidedly serrate on margin, with long-toothed apex and long, slender petioles which cause the leaves to quiver when stimulated by a slight breeze only.

LEAF-SCARS—See "Leaf-Scars" under Black Birch, page 124.

FLOWERS—Appear about April before the leaves. Staminate occur in solitary or occasionally paired aments which are about 1¼-1½ inches long and ⅛ of an inch wide during the winter, but develop in spring to a length of 2-4 inches. Pistillate are cylindrical, slender, about ½ of an inch long and stalked.

FRUIT—A slender, cylindrical, stalked strobile about ¾ of an inch long and obtuse at the apex. Scales are small and downy; their lateral lobes broad and recurving, while the terminal one is rather straight and narrow. Seeds small, oval and winged. Wings are broader than the seed.

WOOD—Diffuse-porous; rays inconspicuous; light, soft, not strong, not durable; heartwood light brown; sapwood light. Weighs 36 pounds per cubic foot. Used for fuel, and in the manufacture of paper pulp, spools, shoe pegs, and hoops for barrels.

DISTINGUISHING CHARACTERISTICS—The Gray Birch, also known as Oldfield, White, Poverty, or Poplar Birch, can be distinguished from all the other Birches of Pennsylvania, except the native Paper Birch, and the commonly introduced European White Birch, by its white bark which is never renewed when once removed. The bark is close, dull white, and marked with black triangular blotches just below the insertion of the lateral branches, and does not peel off in thin paper-like layers like that of the Paper Birch. The Gray Birch is usually a small tree with a rather continuous trunk and frequently occurs in clumps. The twigs of the Gray Birch are also rougher than the Paper Birch and its leaves are long-acuminate, while those of the Paper Birch are ovate.

RANGE—Nova Scotia south to Delaware and southern Pennsylvania, west to the southern shores of Lake Ontario.

DISTRIBUTION IN PENNSYLVANIA—Occurs chiefly in the northeastern and northern parts. Common in Monroe, Schuylkill and Pike counties. Abundant along streams in northern part of the State and on the piles of coal refuse (culm) in the anthracite region. Pure stands occur near Tamaqua, Schuylkill county. A few specimens found on The Knob of South Mountains, in Adams county, near Mason and Dixon line, and on Tussey mountain in Huntingdon county. A pure stand of medium and large trees occurs south of Easton, Northampton county.

HABITAT—Usually occurs on moist soil along streams, ponds, and lakes; also grows on hillsides and occasionally on rocky mountain tops.

IMPORTANCE OF THE SPECIES—The Gray Birch is of little commercial value on account of the small size which it attains due to its short life. The existing stands should, however, be conservatively utilized. It cannot be recommended for forest planting, but is an extremely attractive tree for ornamental purposes.

BLACK BIRCH

Betula lenta, Linnaeus

FORM—This tree usually attains a height of 50-60 ft. with a diameter of 1-3 ft., but may reach a height of 80 ft. with a diameter of 5 feet. Trunk rather continuous, sometimes subdivided, bearing long, slender, lateral branches which are ascending on young trees forming a narrow conical crown, or often pendulous on old specimens forming a wide spreading crown.

BARK—On old trunks (Fig. 90) distinctly black, broken into large, thick, irregular plates which are smooth on the surface; on younger parts of the trees (Fig. 89) smooth, shining, very close fitting, reddish-brown, with sweet wintergreen taste and covered with horizontally-elongated lenticels.

TWIGS—During the first summer light green and hairy, later becoming reddish-brown smooth, shining, with pronounced wintergreen-like flavor. Terminal twigs slender and elongated, while lateral spurs are numerous, stout, and short.

BUDS—Alternate, about ¼ of an inch long, conical, sharp-pointed, shining, covered with reddish-brown overlapping scales with downy margins. Three bud-scales usually visible on buds of terminal shoot and from 5-8 on lateral spur shoots.

LEAVES—Alternate, simple, ovate, usually heart-shaped at base, serrate on margin, long-pointed at apex, dark green above, pale green below, 2½-5 inches long, 1½-3 inches wide.

LEAF-SCARS—Alternate, small, semi-oval in outline, containing 3 rather small, equidistant bundle-scars.

FLOWERS—Appear about April before the leaves. Staminate formed in fall, remaining over winter as aments about ¾ of an inch long, in clusters of usually three, which elongate to about 3 or 4 inches the following spring. Pistillate are about ½-¾ of an inch long, slender, and pale green.

FRUIT—A strobile about 1½-2 inches long, sessile, smooth, erect, with smooth 3-lobed scales and small winged nutlets. Lobes of the scales are about equal in length but the terminal is narrower and sharper-pointed.

WOOD—Diffuse-porous; rays indistinct; heavy, strong, hard, dark brown, with thin yellowish sapwood. Weighs 47 lbs. per cubic foot. Used for furniture, often in imitation of Mahogany, and for hardwood distillation and interior finish; also substituted for Cherry and occasionally for Hickory. Trees cut in spring at about the time the buds open, bleed more than any other tree, but the sap contains less saccharine material than that of the Maples.

DISTINGUISHING CHARACTERISTICS—The Black Birch, also known as Sweet Birch, and Cherry Birch, can be distinguished from all the other species of Birch in Pennsylvania by its close, blackish, cherry-like bark which does not peel off into film-like layers. It closely resembles the Yellow Birch but the latter has yellow bark which peels off into thin film-like layers. The twigs have a distinctly wintergreen-like flavor which is absent in the other species. The scales of the fruit of the Black Birch are smooth and about equally lobed while those of the Yellow Birch are hairy and irregularly lobed.

RANGE—Newfoundland to Florida, west to Ontario, Illinois and Tennessee.

DISTRIBUTION IN PENNSYLVANIA—Common throughout the State. Locally abundant, especially in the mountainous regions.

HABITAT—Usually found in rich soil and on dry slopes but also common on rocky mountain slopes and tops. Common on the rock ridges of the South Mountains in Pennsylvania.

IMPORTANCE OF THE SPECIES—The Birches, next to the Hickories, furnish the best fuel wood of all the native species of Pennsylvania. The wood of Black Birch ranks high as a fuel wood and is become more important in the manufacture of furniture, especially as a substitute for Mahogany and Cherry. This tree also yields an oil sold as a substitute for wintergreen. The manufacture of this oil has been carried on rather extensively on a few State forests in the northern part of the State. While this tree has many good qualities still it is a slow grower and when quite young is subject to the attack of fungi, which materially decrease the technical value of the wood. It is not of sufficient importance to be regenerated artificially but should be developed where it occurs naturally. It occurs naturally upon extremely rocky ridges and may be a very desirable tree in establishing protection forests upon steep mountain slopes and rocky mountain tops.

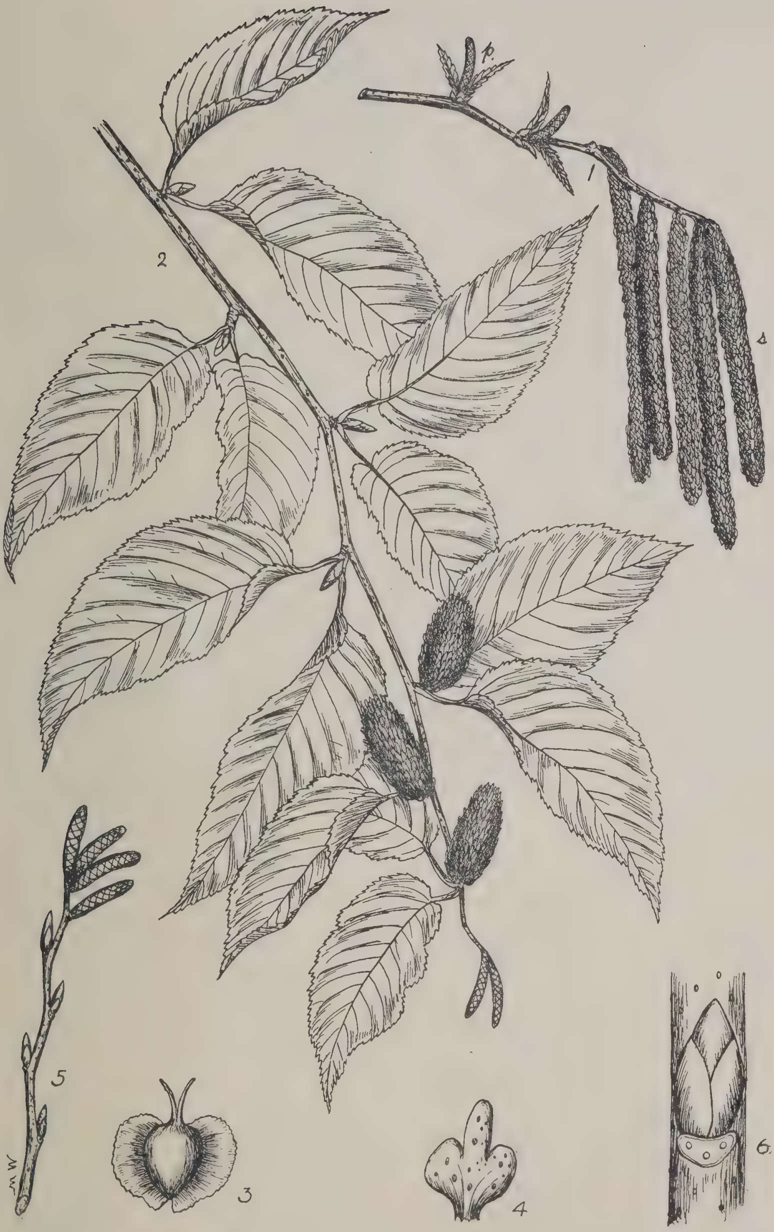

PLATE XLVII. BLACK BIRCH

1. Flowering branch with (s) staminate flowers, (p) pistillate flowers, x ½.
2. Branch with mature leaves and three fruiting strobiles, x ½.
3. A winged seed, enlarged.
4. A strobile scale, enlarged.
5. Winter branch with partly developed terminal staminate aments, x ½.
6. Section of a winter twig, enlarged.

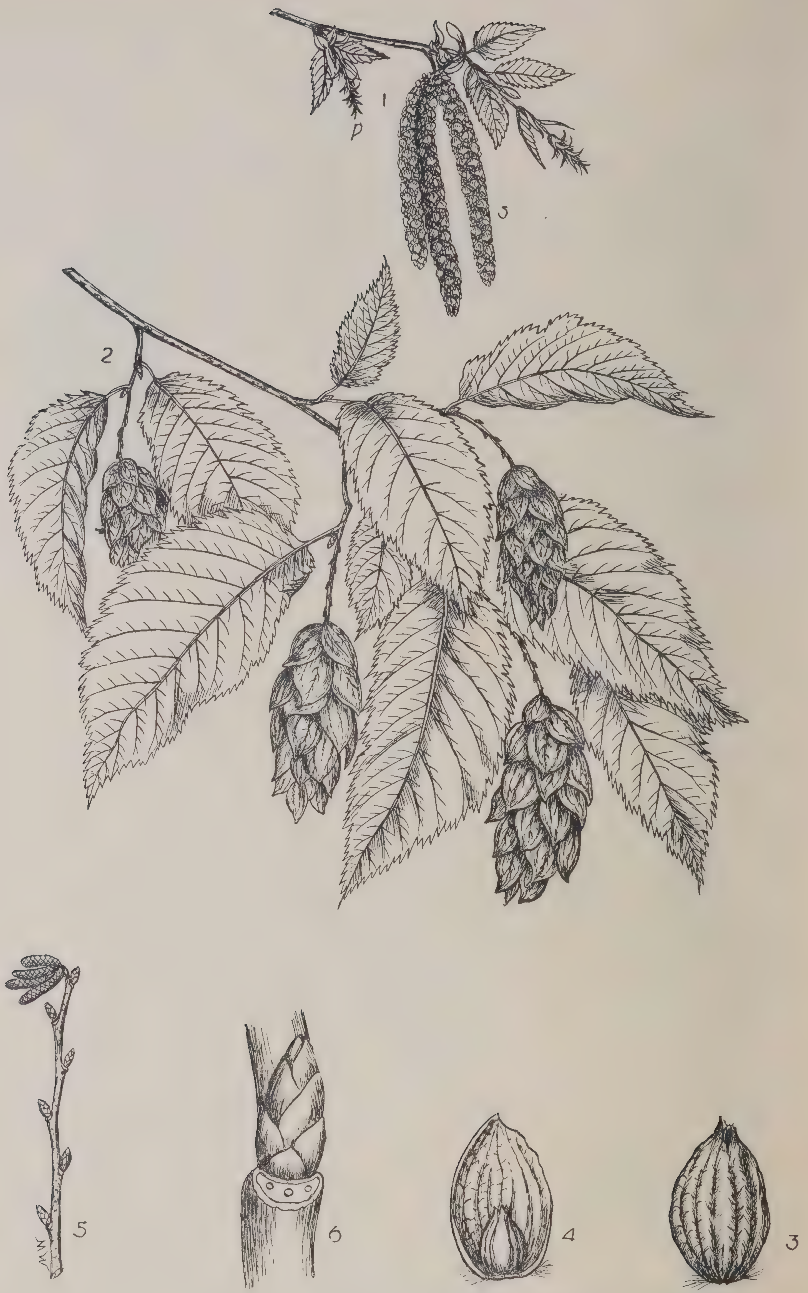

PLATE XLVIII. AMERICAN HOP HORNBEAM

1. Flowering branch with immature leaves, (s) staminate flowers, (p) pistillate flowers, x ½.
2. Branch with mature leaves and hop-like fruit clusters, x ½.
3. A seed with inclosing membrane, slightly enlarged.
4. A seed with part of inclosing membrane removed, slightly enlarged.
5. A winter branch with partly developed terminal staminate aments, x ½.
6. Section of winter twig, enlarged.

AMERICAN HOP HORNBEAM

Ostrya virginiana, (Miller) K. Koch

GENUS DESCRIPTION—This genus comprises about 4 species which are widely distributed in the northern hemisphere. Two species are native to America and 2 to the eastern hemisphere. One of the American species is more limited in its distribution than any other known tree, being found ouly in the Grand Canon of the Colorado River in Arizona while the other American species is rather widely distributed over the eastern part of the country.

FORM—Usually attains a height of 20-30 ft. with a diameter of 1½ ft., but may reach a height of 60 ft. with a diameter of 2 feet. Crown high, open, and very broad, formed by widely spreading often drooping branches with ascending branchlets.

BARK—Grayish-brown, thin, roughened by loose flattish scales which are loose at the ends. See Fig. 73.

TWIGS—Slender, tough, dark, reddish-brown, zigzag, at first hairy and green, later smooth, lustrous, dark brown.

BUDS—Alternate, axillary; terminal bud absent; ovate, ¼ of an inch long, sharp-pointed, distinctly divergent, slightly pubescent, smooth, gummy, covered by about 8 visible, longitudinally-striated, 4-ranked scales which increase in size from the base towards the apex.

LEAVES—Alternate, simple, ovate-oblong, acute at apex, doubly-serrate on margin, rounded or heart-shaped or wedge-shaped at base, 3-5 inches long; dull yellowish-green above, paler green below.

LEAF-SCARS—Alternate, small, flattened, 2-ranked, with usually 3 small bundle-scars.

FLOWERS—Appear about April with the leaves. Staminate aments appear about midsummer usually in about 3s at the end of the twigs and persist during the winter; they are stiff, hairy, about ½ of an inch long, becoming about 2 inches long in spring and covered with reddish-brown scales. Pistillate flowers appear in erect aments, each one inclosed in a hairy bladder-like bract.

FRUIT—A small flat nutlet, inclosed in an inflated bladder-like bract which is covered at the base with long hairs irritating to the skin. Bracts arranged in hop-like, pendant clusters which fall during winter and leave the persisting naked stalk.

WOOD—Diffuse-porous; rays indistinct; strong, hard, durable, light brown to white. Weighs about 51 lbs. per cubic foot. Used for fence posts, tool handles, and mallets.

DISTINGUISHING CHARACTERISTICS—The American Hop Hornbeam, also known as Ironwood, Leverwood, and Deerwood, can readily be recognized by its thin grayish-brown bark which peels off into narrow flat scales often loose at both ends and only attached in the middle. The hop-like clusters of sac-like fruit are also peculiar, which usually fall before winter but the stalks to which they are attached often persist. In winter the very slender interlacing branches, the staminate catkins usually occurring in 3s at the end of the twigs, the small 2-ranked leaf-scars with 3 bundle-scars, and the small reddish-brown buds with 4-ranked scales are characteristic. The autumnal color of the leaves is yellow while that of the closely related American Hornbeam is brilliant orange to deep scarlet. The hardness of the wood is also distinctive. The wood is about 30 per cent stronger than White Oak.

RANGE—Cape Breton Islands to Florida, west to Minnesota and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State but nowhere abundant. Usually mixed with other species. Rarely conspicuous in the composition of the forest.

HABITAT—Prefers dry gravelly slopes and ridges, occasionally moist situations. Usually seeks cool and shaded places, and is not found in pure stands or groups, but occurs singly in mixture, often as an undergrowth of Oak, Maple, Chestnut, and other forest trees common to its range.

IMPORTANCE OF THE SPECIES—The American Hop Hornbeam produces a valuable wood and grows rapidly, but its solitary habits as well as its silvicultural characteristics and the relatively small size which it attains, do not recommend it for forestry purposes. It is well adapted for planting in laws and parks,

AMERICAN HORNBEAM

Carpinus caroliniana, Walter

GENUS DESCRIPTION—This genus comprises about 12 species which are confined to the northern hemisphere. Only 1 species is found in America. A few of the other species are native to Europe, while most are found in northern and central Asia.

FORM—A small tree or shrub usually attaining a height of 10-30 ft., with a diameter of 8-12 inches, but may reach a height of 40 ft. with a diameter of 2 feet. Trunk usually short, fluted, and bearing a wide-spreading usually round-topped crown with tough ascending branches often pendulous towards the end.

BARK—Vertically corrugated, smooth, thin, close-fitting, bluish-gray tinged with brown. See Fig. 112.

TWIGS—Slender, at first silky, hairy, and green, later smooth, shining, reddish to orange; covered with scattered pale lenticels.

BUDS—Alternate, axillary, terminal bud absent; ovate, pointed, ⅛ of an inch long, reddish-brown, covered with 8-12 visible 4-ranked bud-scales. Bud-scales increase in size from the base towards the apex, are longitudinally-striate and often ciliate on margins.

LEAVES—Alternate, simple, ovate-oblong, acute at apex, doubly-serrate on margin, rounded or wedge-shaped at base, 2-4 inches long, deep green above, paler below.

LEAF-SCARS—Alternate, small, elevated, elliptical, with generally 3 inconspicuous bundle-scars.

FLOWERS—Appear about April with the leaves. Staminate start to develop in fall and remain over winter in the form of buds which resemble the leaf-buds, only are larger. When fully developed they are drooping aments about 1½ inches long. Pistillate appear as aments, about ⅔ of an inch long, with bright scarlet styles.

FRUIT—A small corrugated nut about ⅓ of an inch long inclosed by a leaf-like, 3-lobed bract which is usually serrate only on one margin of middle lobe.

WOOD—Diffuse-porous; rays conspicuous and broad along short radii; heavy, hard, strong, light brown, with broad sapwood. Weighs about 45 lbs. per cubic foot. Used for fuel, tool handles, and levers.

DISTINGUISHING CHARACTERISTICS—The American Hornbeam, also known as the Blue Beech, Ironwood, and Water Beech, may be distinguished by its vertical, corrugated, bluish-gray, smooth bark. The leaf-like 3-lobed bract with its corrugated nut is also characteristic. The staminate catkins remain in the bud during the winter, while those of the American Hop Hornbeam are developed in autumn. It resembles the American Beech, but can readily be distinguished from it by its corrugated bark and the absence of the long, slender, conical, and sharp-pointed buds so characteristic of the Beech. The buds are usually downy at the apex while those of the American Hop Hornbeam are smooth and slightly gummy within. The autumnal color of the leaves is brilliant orange to deep scarlet.

RANGE—Nova Scotia to Florida, west to Minnesota and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State and frequently abundant in localities where wet habitats are plentiful.

HABITAT—Usually found in swamps and on the border of streams, whence its name Water Beech. In Pennsylvania it is found in the valleys, along streams, in swamps, and in similar habitats on the mountain flats and on moist, fertile mountain slopes.

IMPORTANCE OF THE SPECIES—The American Hornbeam on account of its small size, slow growth, and preference for wet locations is of little commercial importance. It cannot be recommended for forestry purposes but is attractive as an ornamental tree on account of its fluted bark, peculiar branching, and the beautiful orange and scarlet autumnal foliage.

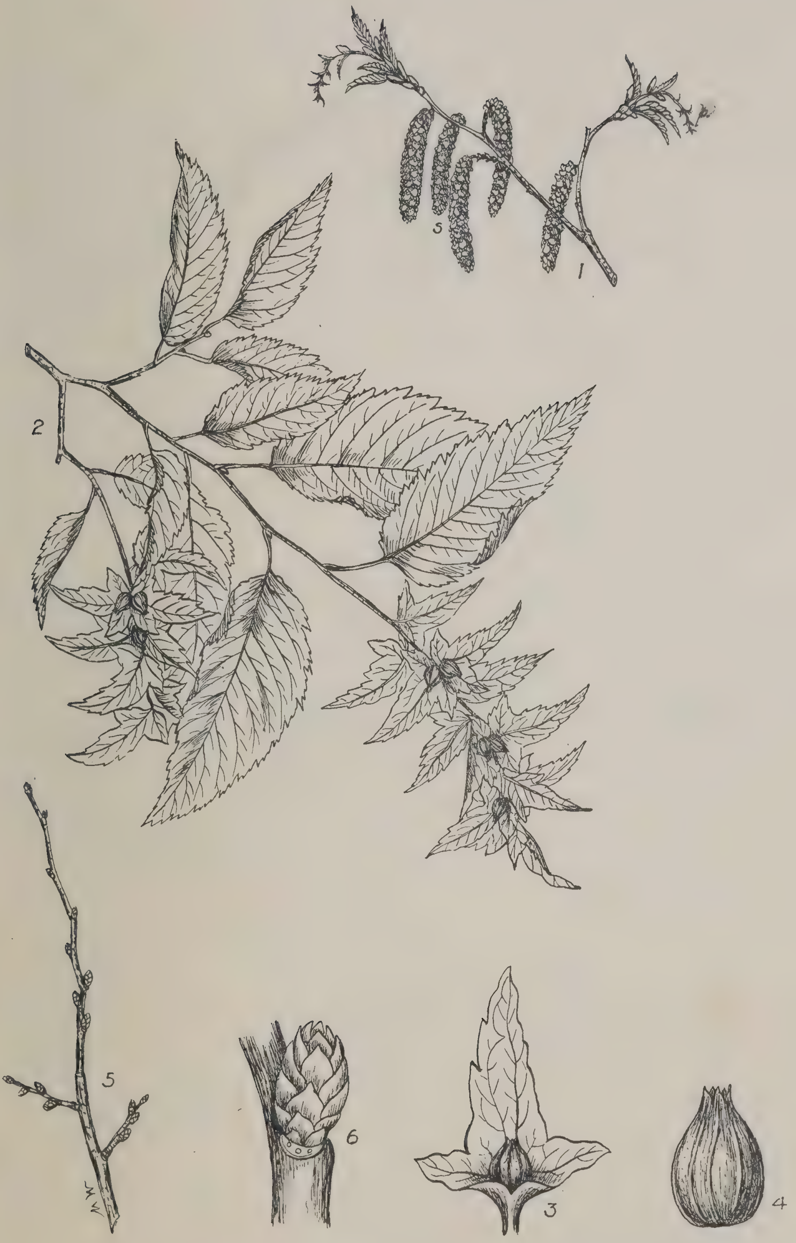

PLATE XLIX. AMERICAN HORNBEAM

1. Flowering branch with immature leaves, (s) staminate flowers, (p) pistillate flowers, x ½.
2. Branch with mature leaves and fruit, x ½.
3. A nut with subtending bract, slightly enlarged.
4. Nut with bract removed, enlarged.
5. A winter branchlet, x ½.
6. Section of winter twig, enlarged.

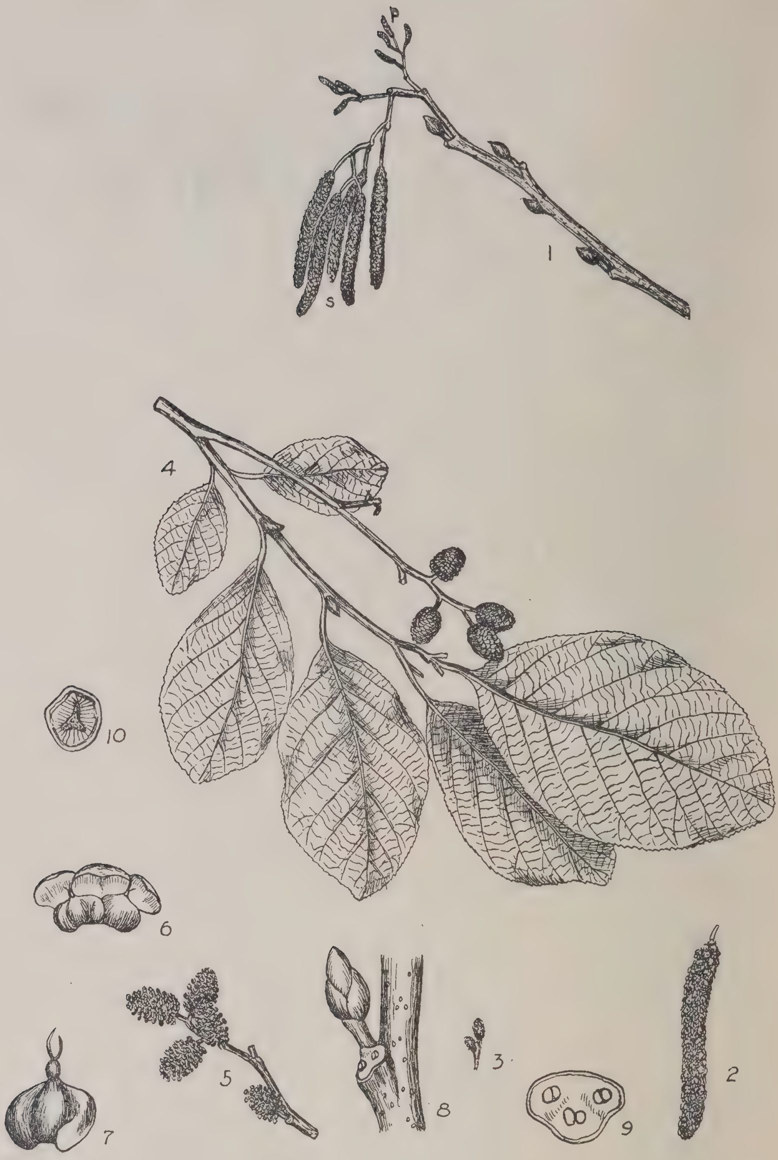

PLATE L. SMOOTH ALDER

1. Winter branch showing buds, (s) staminate catkins, (p) pistillate catkins, x ½.
2. A mature staminate catkin, x ½.
3. Mature pistillate catkin, x ½.
4. Branch with leaves and fruit, x ½.
5. Branch with mature fruit strobiles, x ½.
6. A strobile scale with seeds, slightly enlarged.
7. A winged seed, enlarged.
8. Section of winter branch showing stalked bud, lenticels, leaf-scar with bundle-scars, slightly enlarged.
9. A leaf-scar, enlarged.
10. Cross section of branch showing triangular pith, enlarged.

SMOOTH ALDER

Alnus rugosa, (Du Roi) Sprengel

GENUS DESCRIPTION—The Alders comprise about 25 known species, of which number about 10 are native to North America and 2 to Pennsylvania. The members of this genus are distributed widely in the northern hemisphere and extend south through Central America and along the Andes Mountains to Bolivia. Most of them are shrubs or small trees, while a few attain a fair tree-size.

FORM—A small shrub usually from 4-10 ft. in height. Sometimes solitary, usually in clumps, often forming thickets which are almost impenetrable, especially in wet locations.

BARK—Thin, smooth, fluted, astringent, at first brownish-green, later grayish-green, and often covered with white blotches.

TWIGS—Rather slender, at first greenish, later greenish-brown and finally grayish-brown. Often grayish-white towards end of fruiting twigs. Lenticels numerous, scattered, brownish, roundish or longitudinally-elongated. Pith greenish and irregular or triangular.

BUDS—Alternate, evidently stalked, about ½ of an inch long; greenish-red, laterally compressed, blunt-pointed, apparently covered with two valvate scales which in reality are stipules. Stipular bud-scales are often whitish towards apex and usually slightly sticky.

LEAVES—Alternate, simple, obovate, blunt-pointed or rounded at apex, usually wedge-shaped at base, almost regularly serrate on margin, at first slightly gummy, later smooth, rather thick, 2½-4¼ inches long; green on both surfaces, but darker on upper surface, brownish pubescent below especially in the axils of the veins. Veins depressed above and ridged below.

LEAF-SCARS—Alternate, raised, usually 2 or 3-ranked, somewhat triangular, containing about 3 bundle-scars which are often compounded. Stipule scars narrow, triangular, brownish and very close to leaf-scars.

FLOWERS—Appear in March or April before the leaves. Staminate and Pistillate occur separately but on the same twig. Staminate arranged in aments which develop partly in previous autumn and remain dormant over winter. In winter they are stiff, pendant, greenish, and about one inch long; in clusters of 2-5 at the end of bare stalks. Pistillate also develop in the previous autumn and remain dormant over winter, about ¼-½ of an inch long, usually clustered in 2s or 3s and greenish to purplish in color. The first warm days of spring bring forth the scarlet styles of the pistillate flowers.

FRUIT—A cone-like woody structure, about ½-¾ of an inch long, orbicular, persistent, composed of thick and woody scales on which the little, practically wingless, round and flattened nutlets are produced.

WOOD—Diffuse-porous; growth of rings distinct; rays variable in width. Sapwood turns yellowish-brown upon exposure.

DISTINGUISHING CHARACTERISTICS—The Smooth Alder, also known as Black Alder, can be distinguished by the woody cone-like fruit which is usually present at all seasons of the year. The wet habitats which it frequents may also aid in recognizing it. In the spring it is one of the first of our small trees to blossom. In summer the stiff leaves with their rounded apexes are also characteristic. In winter the mature fruit, developing staminate and pistillate flowers, stalked buds, and triangular green pith, are distinctive. The only other Alder native to Pennsylvania is the Speckled or Hoary Alder (Alnus incana (L.) Moench). This species can be distinguished from the Smooth Alder by its leaf-blades which are usually glaucous or finely pubescent underneath and rounded at the base.

RANGE—Essentially a southern species, extending from Maine to Florida and Texas and westward to Minnesota. Sparse and often entirely absent along the streams flowing through limestone soil.

DISTRIBUTION IN PENNSYLVANIA—Very common in the eastern and southern parts of the State. Sparse, but locally abundant in northern and western parts.

HABITAT—Common along streams and in swamps. Rarely ascends the hillsides. In wet situations it often forms dense thickets. Disappears from the banks of streams as soon as they reach limestone soil.

IMPORTANCE OF THE SPECIES—The two species of Alder native to Pennsylvania do not attain a size which makes them important commercially. They may be of value as soil-binders and soil conservers along the banks of streams or in very wet situations since they develop large and strong roots that throw off many suckers.

HAZELNUT

Corylus americana, Walter

GENUS DESCRIPTION—The Hazelnuts comprise about 7 known species, of which number about 3 are native to North America and 2 to Pennsylvania. The members of this genus are usually shrubs, rarely trees, found in the northern hemisphere. They do not produce wood of any commercial importance, but their fruit, which is a nut, is very common in our markets. The nuts are sold under the name of Hazelnuts or Filberts.

FORM—A shrub or small tree reaching a height of 3-8 feet. Occurs in clumps and often forms thickets.

BARK—Rather smooth, thin, dark brown, sometimes roughened with shallow longitudinal fissures.

TWIGS—Smooth but marked with a few scattered lenticels, and covered with numerous pinkish hairs which usually stand at right angles to the twigs; gray to russet-brown in color.

BUDS—Alternate, ovate to globular, reddish-brown, somewhat hairy, covered with about 3-6 scales with hairy and slightly glandular margins.

LEAVES—Alternate, simple, ovate, obtuse or heart-shaped at base, acute at apex, serrate on margin, smooth on upper surface and slightly hairy on lower surface.

LEAF-SCARS—Alternate, semi-circular to globular, raised, with scattered bundle-scars usually 5-10 in number.

FLOWERS—Appear in April or May before the leaves. Staminate occur in catkins which usually appear before the leaves at the end of the twigs of the previous season's growth and are 3-4 inches long. Pistillate are small, develop from short scaly buds, with long, slender, projecting, crimson stigmas.

FRUIT—A pale brown ovoid nut about ½ of an inch long, slightly flattened, somewhat roughened at base where the involucre is attached. Involucre consists of two leafy bractlets which are distinct in the Common Hazelnut and united into a tubular beak in the Beaked Hazelnut. Ripens in July and August. Kernel sweet and edible.

DISTINGUISHING CHARACTERISTICS—The Hazelnuts, also known as American Hazel and Filbert, can be recognized by its characteristic fruit, which consists of a nut with a leafy involucre of 2 distinct bracts. The closely related Beaked Hazelnut (**Corylus rostrata, Alt.**) has its bracts united and much prolonged into a narrow tubular beak. The young twigs are covered with numerous somewhat glandular pinkish hairs. The staminate flowers, occurring in catkins which develop somewhat in autumn and then remain dormant over winter, are characteristic. The partially developed staminate aments are often abnormal and twisted due to the attack of some organic agent.

RANGE—Maine and Ontario, south to Florida and Kansas. The Beaked Hazelnut ranges from Quebec to British Columbia, south to Georgia and Missouri.

DISTRIBUTION IN PENNSYLVANIA—Both species of Hazelnut are found locally throughout the State.

HABITAT—Both species frequent the borders of woodlands, hillsides, thickets, and loose stone fences. The Beaked Hazelnut is, however, restricted more to mountainous areas.

IMPORTANCE OF THE SPECIES—These shrubs do not produce any wood of commercial importance, but yield valuable and greatly prized nuts. The nuts are common on our markets. Both Hazelnuts are very attractive and planted extensively for ornament purposes.

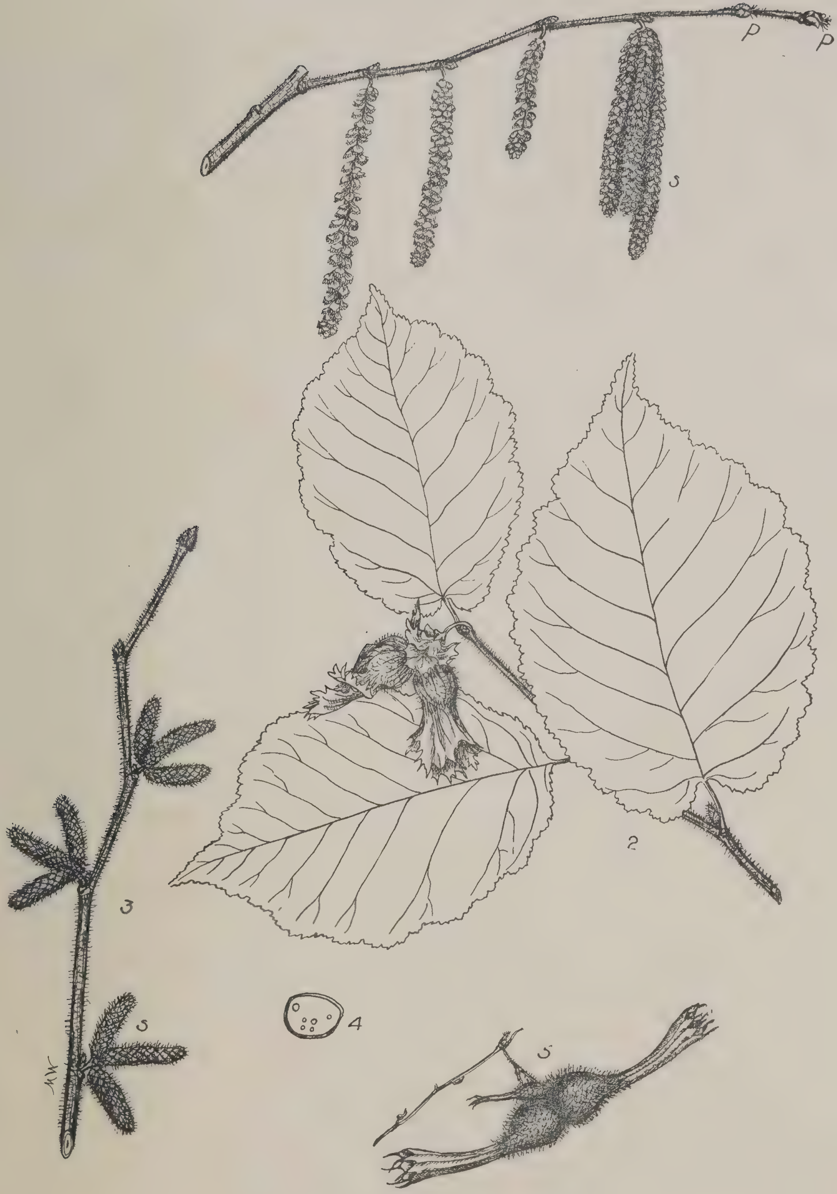

PLATE LI. HAZELNUT

1. Branch with (s) staminate flowers, and (p) pistillate flowers, x ½.
2. Branch with leaves and fruit, x ½.
3. Winter branch with dense cover of hairs showing (s) staminate catkins, x ½.
4. Leaf-scar with bundle-scars, enlarged.
5. Fruit of Beaked Hazelnut (Corylus rostrata), x ½.

THE BEECH FAMILY—FAGACEAE

The Beech family contains some of the most important timber trees and has its representatives distributed in nearly all regions of the world. The Pine family alone surpasses this one in economic importance. It yields not only high grade wood but also food in the form of nuts, tanning and dyeing materials, and cork. The wood is of a high grade and used extensively.

The members of the Beech family have alternate, simple, pinnately-veined, mostly deciduous leaves. A division of the family known as the Live Oaks retains its leaves during the winter. The flowers, staminate and pistillate, which are rather inconspicuous, are usually yellowish to greenish in color and found on different parts of the same tree and usually on different parts of the same branch. The inconspicuous flowers of this family stand in strong contrast with the conspicuous flowers of such trees as the Magnolias, Cherries, Apples, Papaw, and other broad-leaved trees. The fruit consists of one or more one-seeded nuts covered by an outer cartilaginous and an inner membraneous covering. It is usually heavy and in some species matures in one season while in others it requires two seasons. On account of the heavy weight of the seeds they usually fall immediately below the tree and remain there unless disseminated by animals, birds, water, or gravity on slopes. The seed fills the entire cavity of the nut.

This family consists of 6 genera and about 400 species of trees and shrubs of which number 5 genera with about 60 species occur in North America and 3 genera with 19 species in Pennsylvania. The 3 genera not found in Pennsylvania are Castanopsis, Pasania, and Nothofagus. Representatives of Castanopsis and Pasania are found in the western part of the United States, while the genus Nothofagus is confined to the southern hemisphere. The subjoined key will distinguish the 3 genera found in Pennsylvania.

KEY TO THE GENERA

Page

1. Staminate aments in globose heads; nuts triangular; buds long, slender, sharp-pointed, conical, 5 times as long as wide, ...Fagus 130

1. Staminate aments elongated, slender; nuts not triangular; buds shorter, stout dull-pointed, not 5 times as long as wide, ...2

2. Staminate aments erect or ascending; nuts enclosed in a prickly bur; buds covered with a few overlapping scales, terminal ones absent, ...Castanea 130

2. Staminate aments drooping; nuts seated in an open scaly cup; buds covered with many overlapping scales and clustered at the terminal end of twig, ...Quercus 134

BEECH—FAGUS, (Tourn.) L.

The genus Fagus comprises trees with a close, smooth and grayish bark, a light horizontal spray, simple straight-veined leaves, hard and diffuse-porous wood and long, slender, conical, sharp-pointed buds. The members of this genus are limited to the northern hemisphere with only 1 native representative in America and 4 in the eastern hemisphere. One of the latter is widely distributed in Europe and southwestern Asia. It is the Beech which figures in ancient literature and is now known as the European Beech (Fagus sylvatica L.). This tree is now planted extensively for ornamental purposes in America, especially 3 varieties of it, viz:—with purple leaves, cut leaves, and pendant branches respectively. The wood of the European Beech is used extensively in France and Germany for lumber and fuel and the nuts are fed to swine. The nuts also yield a valuable oil. The other species of the eastern hemisphere are found in eastern Asia. The description of the sole native American representative, found on page 131, will suffice for the genus.

CHESTNUT—CASTANEA, (Tourn.) L.

The genus Castanea comprises 5 species of trees and shrubs with furrowed bark, round branchlets without terminal buds, ring-porous wood which is rich in tannin and durable in contact with the soil. The leaves are simple, alternate, stiff, sharp-toothed, and straight-veined. The members of this genus blossom in summer and mature their fruit the same autumn at about the time when the first frost appears. The fruit consists of a large spiny bur in which 1-5 nuts are borne. The nuts are highly prized as food. Three kinds of Chestnuts are cultivated in this country for their fruit, the American, the European, and the Japanese. The Chestnuts are confined to the northern hemisphere, both eastern and western. No representatives are at present found in the western part of North America, but records show that the Chestnut was at one time indigenous to this region. Three species of Chestnut are native in eastern North America, 2 of which attain tree-size, while 1 (Castanea alnifolia, Nutt.) seldom exceeds 3 ft. in height and is found in the south Atlantic states. The subjoined key will aid in identifying the two species native to Pennsylvania.

KEY TO THE SPECIES

Page

1. Large trees; leaves oblong-lanceolate, smooth and green on both sides; nuts 1-5, usually 2-3, in a bur; buds $\frac{1}{4}$ of an inch long covered by smooth chestnut-brown scales, ...C. dentata 132

1. Small trees or shrubs; leaves oblong, whitish downy beneath; nuts rounded, usually one in a bur; buds $\frac{1}{8}$ of an inch long, covered by scurfy red scales, ...C. **pumila** 133

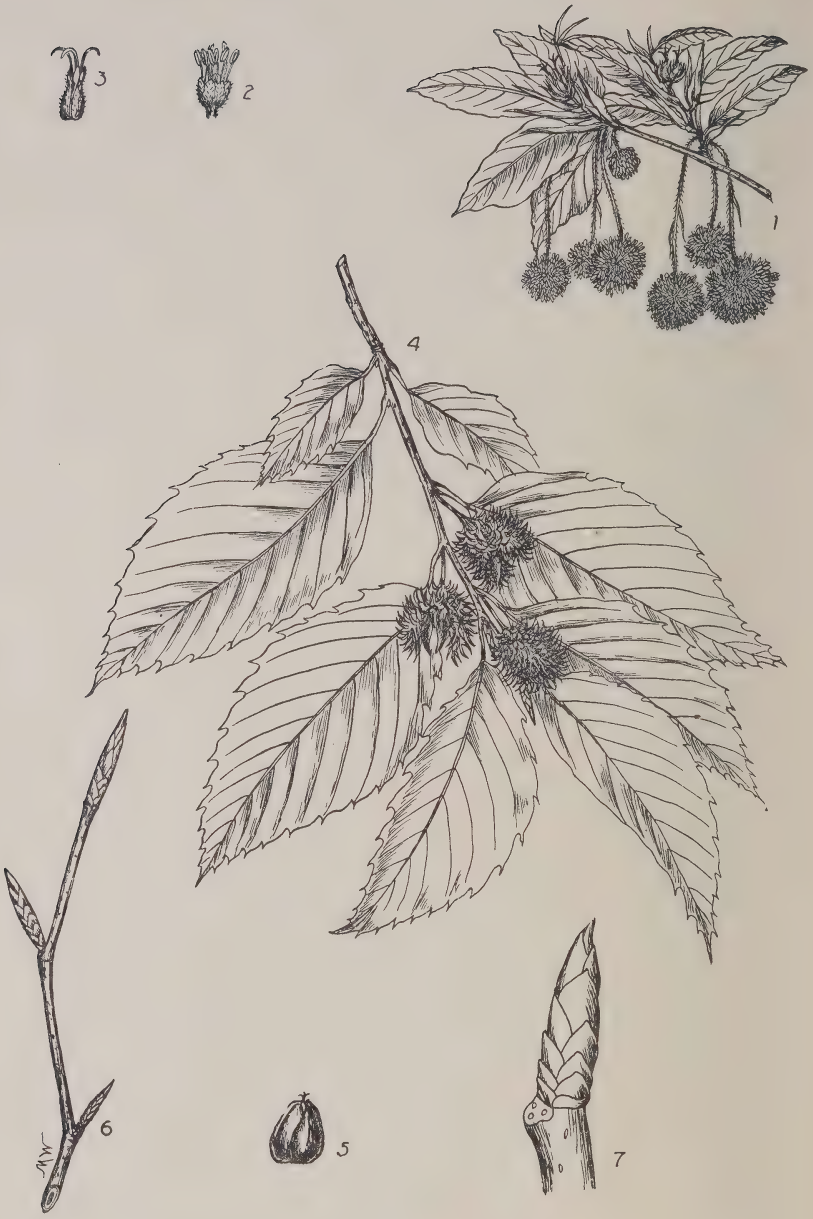

PLATE LII. BEECH

1. Branch with staminate and pistillate flowers and immature leaves, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. A branch with mature leaves and three fruits, x ½.
5. A seed, natural size.
6. A winter branch with long, slender, and sharp-pointed buds, x ½.
7. Terminal section of a winter branch with long, slender, and sharp-pointed bud covered with many overlapping scales, slightly enlarged.

BEECH

Fagus grandifolia, Ehrhart

FORM—Large tree usually attaining a height of 50-60 ft. with a diameter of 2-3 ft., but may reach a height of 125 ft. with a diameter of 4½ feet. Forest grown trees are tall, slender, free from lateral branches for a considerable distance from the base, with a rather compact shallow crown. Open grown trees are short-trunked, covered with many lateral branches which are often drooping below and erect above, forming a dense, deep, symmetrical crown.

BARK—Very close, smooth, light gray, mottled with dark spots. It invites the cutting of initials and other outline carvings. See Fig 111.

TWIGS—Slender, dark yellow to gray, at first hairy, later smooth, zigzag, covered with yellowish lenticels, and marked by bud-scale scars.

BUDS—Alternate; terminal bud present; five times as long as wide, slender, sharp-pointed, conical, usually smooth, covered by 10-20 reddish-brown bud-scales with hairy margins.

LEAVES—Alternate, simple, ovate, 3-4 inches long, stiff leathery, with tapering apex and sharp-toothed margin; light green above, yellowish-green below.

LEAF-SCARS—Raised, crescent-shaped to elliptical with a few scattered bundle-scars. Stipule-scars narrow, almost encircling twig; one end of each stipule-scar is raised above the other end.

FLOWERS—Appear about April when leaves are one-third developed. Staminate flowers occur in a stalked round head about one inch in diameter; pistillate flowers occur in 2-flowered clusters from the axil of the upper leaves.

FRUIT—A stalked, prickly, 4-valved bur containing triangular pale brown, shining nuts with sweet edible kernel.

WOOD—Diffuse-porous with minute pores; broad medullary rays present with narrow ones intervening; hard, strong, tough, not durable, difficult to season, light red in color. Weighs 43 lbs. per cubic foot. Used for railroad ties, parquet flooring, novelty wares, carpenter tools, fuel, and charcoal.

DISTINGUISHING CHARACTERISTICS—The American Beech can readily be distinguished by its close, smooth, light gray bark, its simple, leathery, often persistent leaves, its prickly and stalked fruit with triangular seeds, and its long, slender, conical, sharp-pointed reddish-brown buds.

RANGE—Nova Scotia to Ontario and Wisconsin, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found in every part of the State, but most abundant in the northern part. Heavy stands occur in the northern tier counties. Local in the southeastern and southwestern parts. Rare in the South Mountains of Adams, Cumberland, Franklin, and York counties. Generally absent in the valleys of the southern part of the State.

HABITAT—Commonly found on rich moist bottom lands, but is also abundant on gravelly slopes and rich uplands. It endures dense shade and variations of temperature. Rare in the limestone valleys.

IMPORTANCE OF THE SPECIES—The Beech was formerly not of very much commercial importance, but it is now becoming more important since the process of timber impregnation has been developed. It furnishes excellent fuel and in some regions it is now converted into railroad ties and also manufactured into various by-products on a rather extensive scale. It cannot, however, be recommended for extensive planting for forestry purposes but should be retained and developed in the farmer's woodlot where the production of fuel is important. In the future when more intensive systems for forest management have been developed it can be used for underplanting and as a soil conserver.

CHESTNUT

Castanea dentata, (Marshall) Borkhausen

FORM—A large tree usually attaining a height of 60-80 ft. with a diameter of 3-4 ft., but may reach a height of over 100 ft. with a diameter of 10 feet. A tree with a diameter of 17 ft. has been recorded from Francis Cove, western North Carolina. Open grown trees have short trunks with deep, widespreading crowns. Trees in close stands tall, with little stem taper and few lateral branches.

BARK—On old trunks fibrous, deeply fissured; fissures separate somewhat oblique ridges which are covered with dark brown scales. On young trunks and older branches much smoother. See Fig. 101.

TWIGS—Stout, smooth, greenish to brown, round or angular, swollen at the nodes; covered with numerous small, white, raised lenticels. Pith star-shaped.

BUDS—Alternate, axillary; terminal bud absent; ovoid, ¼ of an inch long, sharp to blunt-pointed; covered by 2-3 dark chestnut-brown scales.

LEAVES—Alternate, simple, oblong-lanceolate, sharp-pointed at apex, toothed on margin, smooth on both lower and upper sides.

LEAF-SCARS—Semi-oval in outline; raised from twig; with numerous, rather inconspicuous, scattered, occasionally clustered bundle-scars.

FLOWERS—Appear in June or July. Staminate are in crowded clusters along ament; pistillate appear at base of upper aments as globular involucres.

FRUIT—Matures in September or October. A bur covered with numerous, prickly spines and containing 1-5, usually 2-3 nuts.

WOOD—Distinctly ring-porous; with indistinct medullary rays; quite strong in young trees, rather weak in older ones; yellowish-brown, very durable, splits easily, rich in tannic acid. Weighs 28 lbs. per cubic foot. Used for railroad ties, telegraph poles, fence posts, rails, cheap furniture, and tannic acid.

DISTINGUISHING CHARACTERISTICS—The Chestnut can readily be distinguished from all other trees except the Chinquapin by its characteristic fruit. See "Distinguishing Characteristics," under Chinquapin, page 133. For Genus Description and key to Species, see page 130.

RANGE—Maine to Michigan, south to Delaware and along the mountains to Alabama, Mississippi and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Very common in the eastern, southern and central parts and locally in other parts. It was formerly the most common tree of Pennsylvania.

HABITAT—Grows almost on any kind of soil, from bottom lands to mountain tops, but does not love limestone or extremely wet soil. In the north it is common on glacial drift but in the south it remains close to mountains and reaches its best development in western North Carolina and eastern Tennessee.

IMPORTANCE OF THE SPECIES—The Chestnut, which reproduces itself by sprout, but also by seed and seedling, was one of the most important commercial trees in this State. It has shown itself to be the surest of all our trees to reproduce a stand fully from sprout. It grows fast and is used for many purposes in small as well as large sizes, and thus can be managed in short rotations, which insures a certain profit on the investment. A Chestnut forest managed for the purpose of producing telegraph poles should be run on rotations of about 55 years. On poor soil it may be necessary to increase the length of the rotation. Good tendance reduces the length of the rotation while the absence of it will not only increase the length but also result in an inferior grade of wood. The great variety of uses to which the wood of Chestnut is put will drain the existing forest to an enormous extent. There is urgent need to reproduce, develop, and improve our existing stands and also to guard against such destructive organic enemies as the Chestnut Bark Disease (Endothia gyrosa var. parasitica) commonly known as the Chestnut Blight. This disease is found in all parts of the State, and has killed practically all stands of commercial trees.

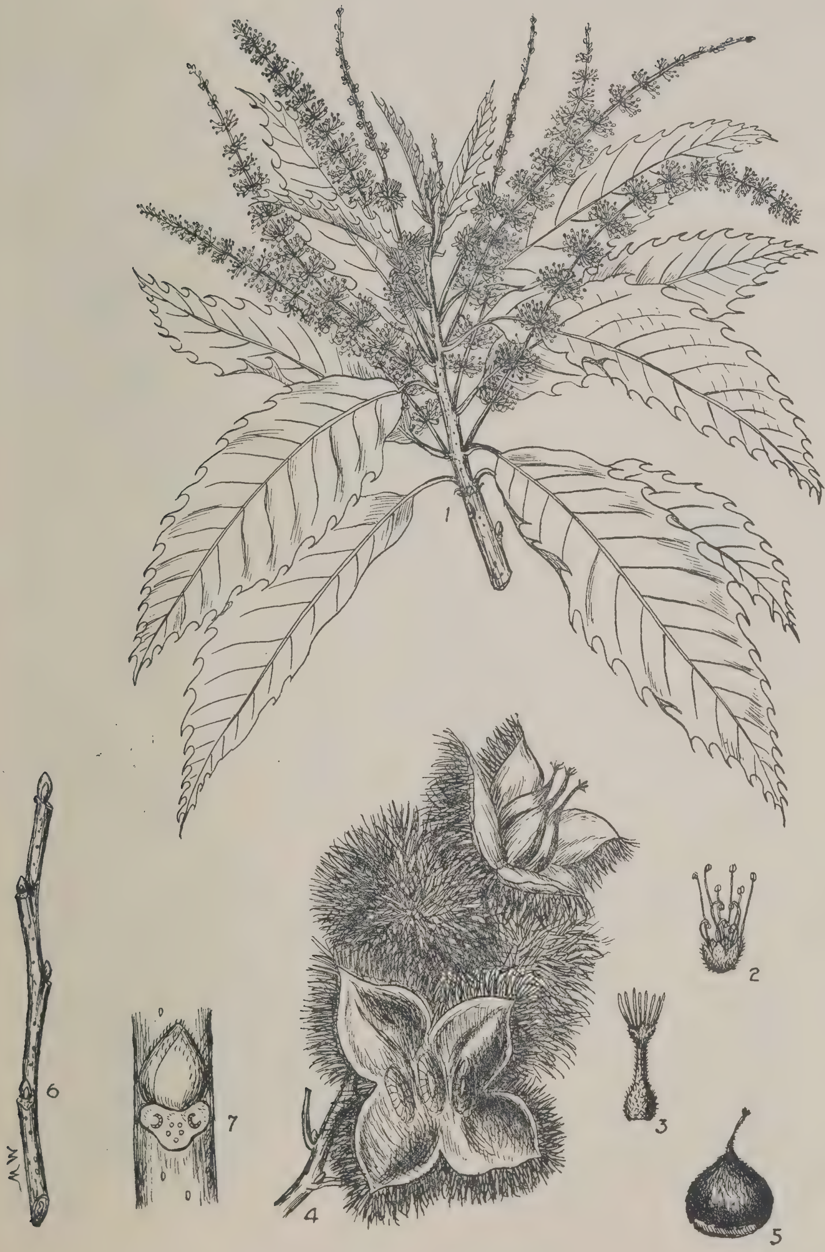

PLATE LIII. CHESTNUT

1. Branch with staminate and pistillate flowers and mature leaves, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. A branch with a cluster of closed and open burs, x ½.
5. A nut, x ½.
6. A winter branch, x ½.
7. A section of winter branch, enlarged.

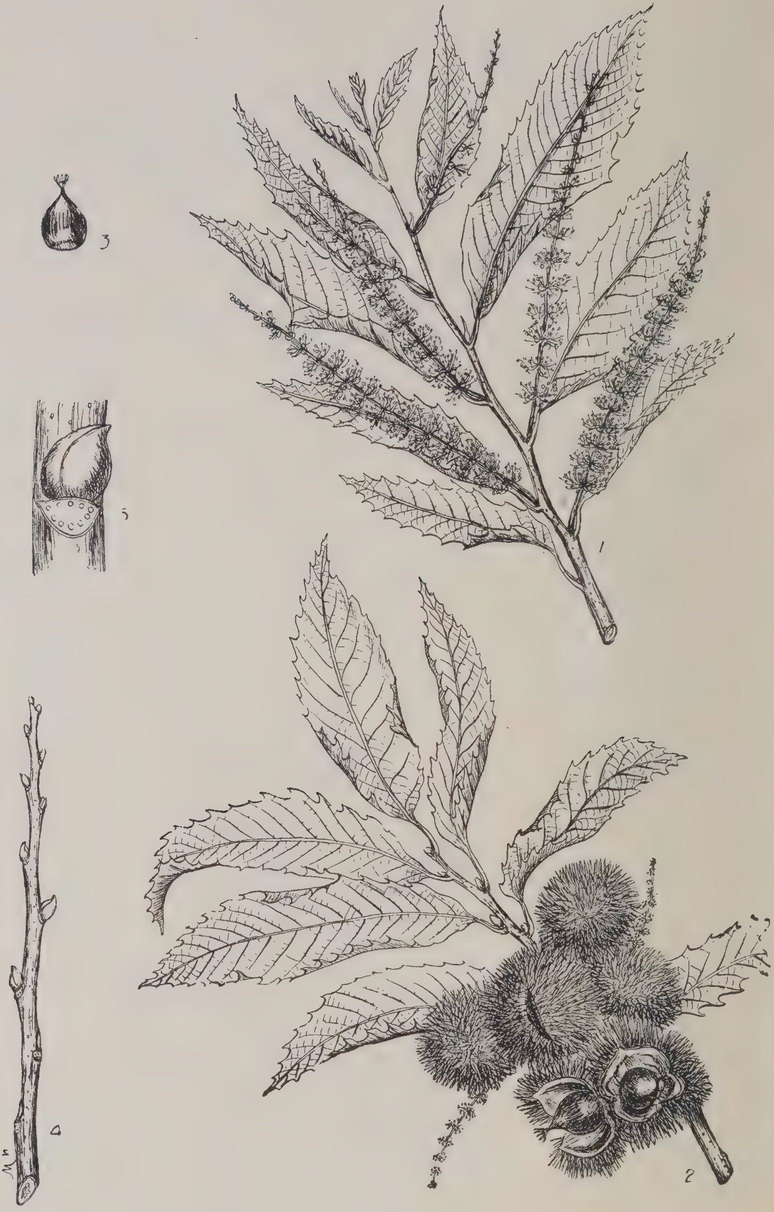

PLATE LIV. CHINQUAPIN

1. A flowering branch with leaves, x ½.
2. A fruiting branch with mature leaves, x ½.
3. A nut, x ½.
4. A winter branch, x ½.
5. A section of winter branch, enlarged.

CHINQUAPIN

Castanea pumila, (Linnaeus) Miller

FORM—A small tree or shrub usually attaining a height of 20-30 ft., but may reach a height of 50 ft. with a diameter of 3 feet. In Pennsylvania seldom exceeds 20 ft. in height and often is only 3-5 ft. in height. Pennsylvania is the northern limit of its distribution. Trunk is usually short and crown roundish.

BARK—May attain a thickness of one inch, usually fissured and broken into light reddish-brown loose plate-like scales. On branches and young trunks rather smooth, dark grayish-brown.

TWIGS—Slender, at first pale woolly, later pubescent, finally smoother, reddish-brown to dark brown; covered with numerous lenticels.

BUDS—Alternate, axillary; terminal but absent; ovoid, blunt-pointed, about ⅛ of an inch long; covered with scurfy red scales.

LEAVES—Alternate, simple, oblong, thick, firm, straight-veined, sharp-pointed at apex, sharply toothed on margin, yellowish-green and smooth on upper surface, pale green and whitish-downy beneath.

LEAF-SCARS—Semi-oval, somewhat raised; with scattered, occasionally clustered, rather inconspicuous bundle-scars.

FLOWERS—Appear in May or June in more or less spreading aments. Staminate occur in crowded clusters along ament; pistillate are grouped at base of upper aments in ovoid, prickly involucres.

FRUIT—Matures in September or October. A bur covered with numerous stiff spines and containing usually 1, seldom 2, ovoid bright brown and sweet nuts with a more or less hairy apex.

WOOD—Ring-porous; with indistinct medullary rays; hard, strong, brown, durable, rich in tannic acid; splits easily. Weighs about 28 lbs. per cubic foot. Used for fence posts, rails, and railroad ties.

DISTINGUISHING CHARACTERISTICS—The Chinquapin is a little brother of the Chestnut which one may see by comparing their characteristic fruit. It can be distinguished from the Chestnut by its smaller size, its whitish down on lower surface of leaf-blades, its smaller scurfy red buds, and smaller burs containing usually one nut. It is found only in the southern part of the State.

RANGE—New Jersey and Pennsylvania to Florida, Missouri, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Locally in a few counties in the southern part of the State. Known to occur in the counties of Franklin, Adams, York, Lancaster, Cumberland, and Chester.

HABITAT—Usually found on dry, sandy slopes, rather fertile hillsides, and margins of ponds and streams.

IMPORTANCE OF THE SPECIES—The Chinquapin is of no commercial importance in this State on account of its small size and its limited distribution. It is very attractive as an ornamental shrub and yields delicious nuts.

THE OAKS—QUERCUS, (Tourn.) L.

The genus Quercus, which consists almost entirely of trees, comprises about 300 species in the world. The Oaks are world famous on account of their wide distribution, physical sturdiness, great strength, and the high commercial value of their wood. Most of them attain a great age and are aggressive competitors in the constant struggle which is going on in the forest. They can be reproduced by sprouts or by seed, naturally or artificially. Their modesty recommends them from a silvicultural point of view since they will grow in habitats which are moist or dry, sterile or fertile, cold, temperate or tropical, at low altitudes or at high altitudes up to the timber line. They prefer the temperate climate.

Economically this genus is one of the most important among the trees. Its wood is used extensively and is especially adapted for high grade work. The bark is rich in tannin, while that of a few European species is used for cork. The galls which are caused by insect stings are also often rich in tannin. The nuts are used in some places as food for man and swine, and occasionally when roasted form a substitute for coffee.

The leaves are alternate, simple, and usually shed in autumn. A division of the Oaks known as the Evergreen or Live Oaks, sheds the leaves at the end of the second or third season. The flowers, staminate and pistillate, appear on different parts of the same tree and often on different parts of the same branch. The staminate or male flowers are small and arranged singly on a long slender and drooping ament which emerges from the buds on the twigs of the previous year's growth. The pistillate or female flowers are small, inconspicuous, urn-like bodies which appear singly or in groups from the base of the developing leaves of the season. The flowers are fertilized by the wind and develop into a nut-like fruit known as an acorn. The fruit is distinctive in having a scaly, often bristly cup separate from the thin-shelled nut which it partly or almost wholly encloses. In autumn the nuts may fall to the ground while the cups persist on the tree, or the nut and cup may fall together. The acorns may germinate immediately after falling to the ground, but usually they remain dormant until the following spring. The seed-leaves of the nut remain in the shell and furnish nourishment to the developing seedling.

A long tap root is characteristic of an oak seedling. This makes them difficult to transplant in a nursery or to plant in the place where they are to develop into large trees. A large part of the first two seasons' growth of many of our Oaks is concentrated mostly in the development of a root system.

The acorns are heavy and disseminated mainly by water, mammals, birds, and gravity on slopes. The fruit of some Oaks matures in one season while others require two seasons. At the end of the first season the latter appear as immature acorns. The mature fruit of the annual fruiting Oaks is attached to the growth of the season, while that of the biennial fruiting Oaks is attached to last season's growth. During the winter season, immature acorns of the biennial fruiting Oaks are found on the growth of the previous season. The Oaks of Pennsylvania may be classified in two groups:

A. Acorns mature in one season; leaves with rounded lobes, not bristle-pointed; shell of nut usually smooth inside; kernel usually sweet; bark pale, often scaly—**WHITE OAKS, ANNUAL OAKS, LEPIDOBALANUS.**

B. Acorns mature in two seasons; leaves or their lobes bristle-pointed; shell or nut usually pubescent inside; bark dark, usually furrowed—**BLACK OAKS, BIENNIAL OAKS ERYTHROBALANUS.**

The subjoined list shows the respective groups to which the several Oaks of Pennsylvania belong:

White Oak group:

1.	White Oak,	Quercus alba.
2.	Swamp White Oak,	Quercus bicolor.
3.	Post Oak,	Quercus stellata.
4.	Chestnut Oak,	Quercus Prinus.
5.	Yellow Oak,	Quercus Muhlenbergii.
6.	Bur Oak,	Quercus macrocarpa.
7.	Chinquapin Oak,	Quercus prinoides.

Black Oak group:

8.	Black Oak,	Quercus velutina.
9.	Red Oak,	Quercus rubra.
10.	Scarlet Oak,	Quercus coccinea.
11.	Pin Oak,	Quercus palustris.
12.	Spanish Oak,	Quercus falcata.
13.	Scrub Oak,	Quercus ilicifolia.
14.	Black Jack Oak,	Quercus marilandica.
15.	Laurel Oak,	Quercus imbricaria.
16.	Willow Oak,	Quercus phellos.

Of the 300 Oaks which are known, about 55 are native of North America, and 16 to the State of Pennsylvania. Of the 16 species native of Pennsylvania, 7 belong to the White Oak group and 9 to the Black Oak group. The centre of distribution of the oaks is in the mountains of Central America and Mexico. A few species are found in Europe. The subjoined keys will identify the oaks native to Pennsylvania:

KEY TO THE OAKS BASED PRIMARILY ON FRUIT AND BUDS

Page

1. Acorns maturing at end of second season on last season's growth; immature acorns may be present in winter; shell of nut hairy inside; scales on acorn-cup usually broad and thin, ...2
1. Acorns maturing at end of first season on growth of season; immature acorns never present in winter; shell of nut not hairy inside; scales of acorn-cup more or less knobby, ...10

2. Buds large; terminal ones usually over one-fifth of an inch long, ...3
2. Buds smaller; terminal ones one-fifth of an inch or less in length, ...7

3. Buds coated with rusty brown hairs prominently angled, ...4
3. Buds not coated with rusty brown hairs; not prominently angled, ...5

4. Inner bark yellow; buds ¼-½ of an inch long; acorn-cup top-shaped to hemispheric, ...Q. velutina 148
4. Inner bark not yellow; buds ¼ of an inch long or less; acorn-cup hemispheric, ...Q. marilandica 151

5. Buds sharp-pointed, ...6
5. Buds, blunt-pointed, the widest part at or just below middle; evidently wooly above middle, ...Q. coccinea 147

6. Acorn-cups saucer-shaped; buds glabrous except sometimes slightly hairy near apex; bark fissured with intervening broad smooth ridges; branches straight, ...Q. rubra 145
6. Acorn-cups hemispheric; buds light brown and hairy; bark shallowly fissured, with scaly ridges, branching zigzag, ...Q. falcata 149

7. Twigs during first winter dull, finally hairy; shrubs, ...Q. ilicifolia 150
7. Twigs smooth and shining during first winter; trees, ...8

8. Pin-like projections on lateral branches numerous, standing almost at right angles to branch; trunk continuous; acorn-cup saucer-shaped, ...Q. palustris 146
8. Pin-like projections not present, trunk divided, ...9

9. Acorn-cups saucer-shaped; buds dark brown; twigs stouter, ...Q. phellos 153
9. Acorn-cups hemispheric; buds light brown and angular; twigs slender, ..Q. imbricaria 152

10. Buds narrow, conical, sharp-pointed, ¼ of an inch or more in length, ...11
10. Buds obtuse, short, usually about ⅛ of an inch long, ...13

11. Buds pubescent, usually sharp-pointed, lateral buds generally appressed; bark on older twigs with corky ridges; acorn-cups fringed, ...Q. macrocarpa 140
11. Buds smooth, lateral buds divergent; twigs without corky ridges; acorn-cups not fringed, ...12

12. Acorns sessile; twigs slender and hairy to smooth, ...Q. Muhlenbergii 142
12. Acorns evidently stalked; twigs stouter and smooth, ...Q. Prinus 143

13. Bark on branchlets peeling into long, dark, layer-like scales; acorns long stalked, ...Q. bicolor 141
13. Bark on branchlets not peeling off into long, dark, layer-like scales, ...14

14. Twigs coated with yellowish-brown wool; buds as long as broad, ...Q. stellata 139
14. Twigs smooth, ...15

15. Twigs slender; shrub or small tree; buds about as long as broad; acorn-cup encloses ½ of nut, ...Q. prinoides 144
15. Twigs stout; large tree; buds longer than broad; acorn-cup encloses ¼ of nut, ..Q. alba 138

KEY TO THE OAKS BASED PRIMARILY ON LEAVES AND FRUIT

Page

1. Leaf-blades or their lobes bristle-tipped; acorns maturing at end of the second season; nuts often pubescent within, ... 2
1. Leaf-blades or their lobes or teeth without bristle tips; acorns maturing at end of the first season; nuts often glabrous within, ... 10

2. Leaf-blades entire; rarely lobed or toothed except on vigorous coppice shoots, ... 3
2. Leaf-blades pinnatifid, pinnately-lobed or dilated at apex, ... 4

3. Lower surface of leaf-blades glabrous, ... Q. phellos 153
3. Lower surface of leaf-blades pubescent, ... Q. imbricaria 152

4. Leaf-blades pinnatifid or pinnately-lobed, ... 5
4. Leaf-blades dilated at apex; brown tomentose on lower surface, ... Q. marilandica 151

5. Leaf-blades green on both upper and lower surfaces, ... 6
5. Leaf-blades pubescent on lower surface, ... 8

6. Lobes of leaf-blades about equal the width of the middle portion or body of the leaf, ... Q. rubra 145
6. Lobes of leaf-blades 2-6 times as long as the breadth of the narrowest portion or body of the leaf, ... 7

7. Trunk continuous, covered by short, slender, often horizontal lateral branches; acorn-cups saucer-shaped, ... Q. palustris 146
7. Trunk usually branched; covered by rather long, usually stout and ascending lateral branches; acorn-cups top-shaped, ... Q. coccinea 147

8. Leaf-blades brown or rusty pubescent on lower surface; inner bark yellow, Q. velutina 148
8. Leaf-blades gray or white pubescent on lower surface; inner bark not yellow, ... 9

9. Lobes of leaf-blades long and lanceolate, often scythe-shaped; large tree, ... Q. falcata 149
9. Lobes of leaf-blades short and triangular, usually five in number; small tree or shrub, ... Q. ilicifolia 150

10. Leaf-blades deeply lobed, ... 11
10. Leaf-blades coarsely toothed, ... 13

11. Mature leaf-blades glabrous and pale on lower surface; cups shallow, ... Q. alba 138
11. Mature leaf-blades pubescent on lower surface; cup encloses at least one-third of nut, ... 12

12. Mature leaf-blades rusty-pubescent below; leaves usually 5-lobed; stellate pubescent below with three terminal large rounded or squarish lobes; upper scales of acorn-cup not awned .... Q. stellata 139

12. Mature leaf-blades white tomentose beneath; leaves usually 5-7-lobed with single large oval and crenate terminal lobe; upper scales of acorn-cup awned with a heavy fringe, ... Q. macrocarpa 140

13. Leaf-blades broadest at or below the middle, oblong to lanceolate, decidedly pointed at apex, usually exceeding six inches in length, ... 14
13. Leaf-blades broadest above the middle, oblong to oblong obovate, pointed to rounded at apex, seldom exceeding six inches in length, ... 15

14. Leaf-blades with acuminate apex; slender petiole; acorn sessile, ... Q. Muhlenbergii 142
14. Leaf-blades with acute apex; stouter petiole; acorn stalked, ... Q. prinus 143

15. Tall tree; bark on small branches often peeling off in dark scales; acorns long-stalked, ... Q. bicolor 141
15. Shrub or small tree; bark on small branches smooth; acorn sessile, ... Q. prinoides 144

WHITE OAK

Quercus alba, Linnaeus

FORM—A very large and valuable tree, usually attaining height of 70-80 ft. but may reach a maximum height of 140 ft. with a diameter of 8 ft. when grown in a closed stand. When grown in a dense stand (Fig. 12) it has a clean continuous trunk often free from lateral branches for 75 ft. with a diameter of 5 ft., and little stem taper. When grown in the open (Fig. 27) it divides near the ground into a great many lateral branches which are gnarled and twisted forming a deep, wide, and irregular crown or occasionally a symmetrical crown. Open grown trees produce a very small quantity of timber of commercial importance. The largest White Oak known in Pennsylvania stood near Kutztown in Berks county. It was 31 feet in circumference at the base and had a branch spread of 105 feet. On March 20, 1923 it was blown down and now this sylvan giant is no more.

BARK—On smaller branches light green to reddish-green; on mature trunks up to 2 inches thick, usually light gray or white, shallowly fissured into flat, irregular scales often very loosely attached. Occasionally the bark of trunk appears roughly ridged and without scales. See Fig. 92.

TWIGS—During first summer light green, tinged with red, coated with loose, pale hairs. First winter slender, smooth, reddish to gray, covered with numerous, light, minute, elevated lenticels. Pith star-shaped.

BUDS—Alternate; terminal buds clustered; broadly ovate, obtuse, reddish-brown, ⅛ of an inch long.

LEAVES—Alternate, simple, 5-9 inches long, 2-4 inches wide, obovate in outline, with 3-9, but usually 7 ascending lobes; lobes blunt at apex and separated by deep round-based sinuses. When full grown thin, bright green and smooth above, and pale, smooth, and occasionally glaucous below.

LEAF-SCARS—Alternate, raised, concave to round above, rounded below. A decurrent ridge often continues from raised leaf-scar which makes the twig 5-angled on account of 5-ranked arrangement of leaf-scars. Bundle-scars are numerous, scattered, inconspicuous. The leaf-scars of the Oaks of this State so closely resemble each other that a description of a leaf-scar of one species will suffice for all.

FLOWERS—Flowers appear in May when the leaves are about ⅓ developed. Staminate flowers are borne in hairy aments 2½-3 inches long. Calyx is very hairy and yellow. Stamens extend beyond calyx. Anthers are yellow and notched. Pistillate flowers are borne on short stalks, with hairy involucral scales and red spreading styles.

FRUIT—An acorn, maturing during one season, sessile or short-stalked. Nut ovoid, rounded at apex, shiny, light brown, ¾ of an inch long, inclosed for ¼ length in cup. Meat of nut is sweet and edible. Cup bowl-shaped, slightly tomentose on inside, covered with numerous scales which are thin, short, flat, blunt-pointed near rim, thickened and knobby near the base.

WOOD—Ring-porous; with very conspicuous medullary rays; strong, heavy, hard, close-grained, durable in contact with soil, light brown with lighter sapwood. The most valuable of all oak wood. Weighs 46 lbs. per cubic foot. Used in construction, ship building, tight cooperage, furniture, railroad ties, manufacture of wagons, agricultural implements, interior finish of houses, fences and fuel.

DISTINGUISHING CHARACTERISTICS—In summer one can distinguish the White Oak very readily by its loose scaly, grayish or white bark from which it takes its common name, and by its deeply round-lobed leaves with a smooth and pale lower surface when mature. In winter it has some characteristics apparently in common with some other Oaks but can be distinguished from the Red, Black, Scarlet, Chestnut, and Yellow Oaks by its obtuse, rather small buds; from the Swamp White Oak by the slender reddish to grayish twigs and the absence of dark loose peeling flakes on the branches; from the Post Oak by the absence of greenish rusty pubescence on the twigs; from the Pin Oak by the absence of stiff lateral pins on the branches and the more obtuse buds; from the Bur Oak by the absence of corky wings on the branches. In addition to these characteristics the acorns and leaves which often persist will aid considerably in recognizing the different species. A careful study of the key to the species will help in bringing out additional distinguishing characteristics.

RANGE—Maine to Minnesota, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Abundant throughout the eastern, central, and southern parts, and rather common at least locally, in the northern and western parts. Not known to occur in Allegheny watershed in Potter and McKean counties. It is the commonest tree in southern Allegheny, Washington, and Greene counties.

HABITAT—It is tolerant of many soils, growing on sandy plains, gravelly ridges, rich uplands, and moist bottomlands. It reaches its best development in rich moist soil.

IMPORTANCE OF THE SPECIES—The White Oak is the most important hardwood species of Pennsylvania. It is a slow grower but develops an exceptionally high grade material. Artificial regeneration by planting is difficult. Sprouting cannot be depended upon. Natural seed regeneration is the best method by which this tree can be successfully reproduced. German experimentation has shown conclusively that the natural method is superior to the artificial, especially with Oak. The great value of its timber will justify attempts to grow the White Oak in forest stands of considerable extent.

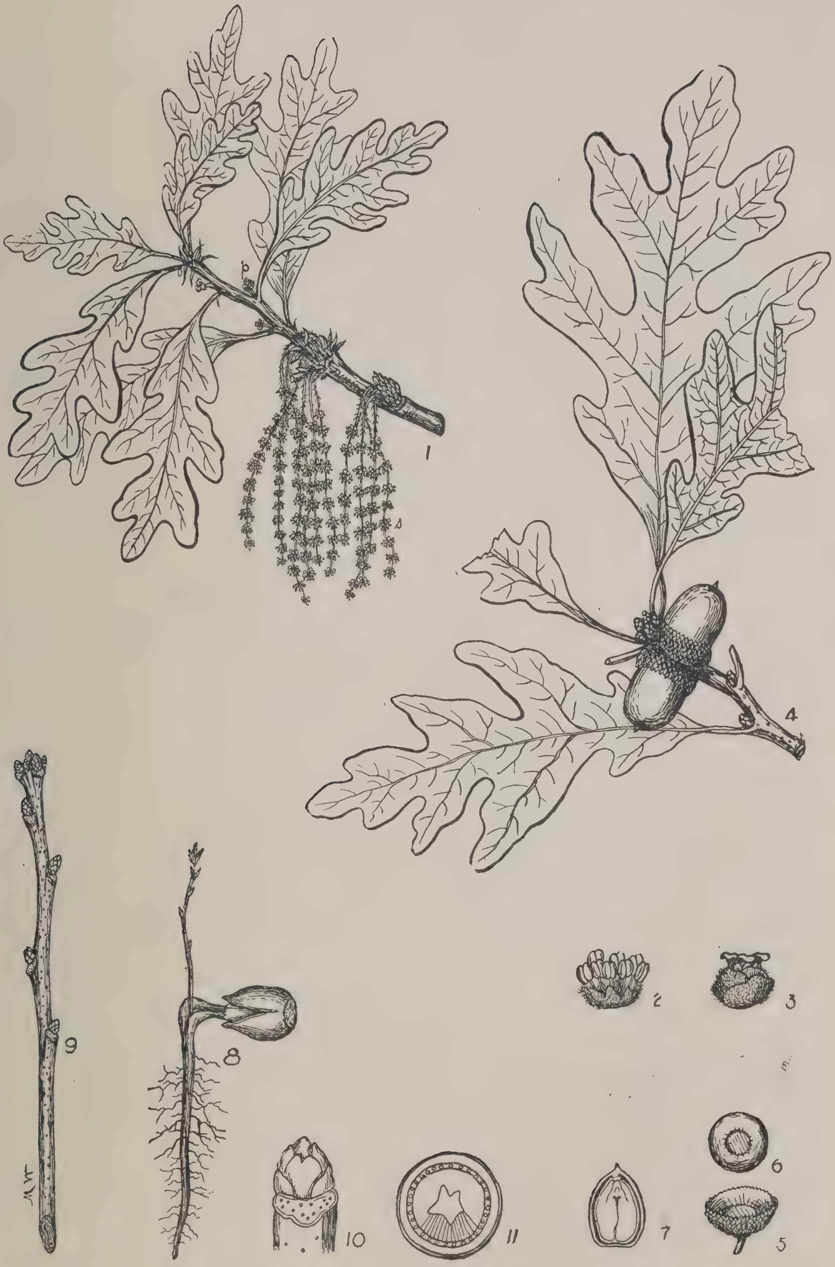

PLATE LV. WHITE OAK

1. Flowering branch with immature leaves (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. Branch with mature leaves and mature acorns, x ½.
5. Acorn cup, x ½.
6. Acorn, basal view, x ½.
7. Longitudinal section of acorn showing embryo, x ½.
8. Germinating acorn with its young root and shoot, x ½.
9. Winter branch, x ½.
10. Terminal section of winter branch showing bud with overlapping scales, a leaf-scar with bundle-scars, and lenticels, enlarged.
11. Cross section of twig showing five-sided pith, wood with conspicuous medullary rays, inner and outer bark, enlarged.

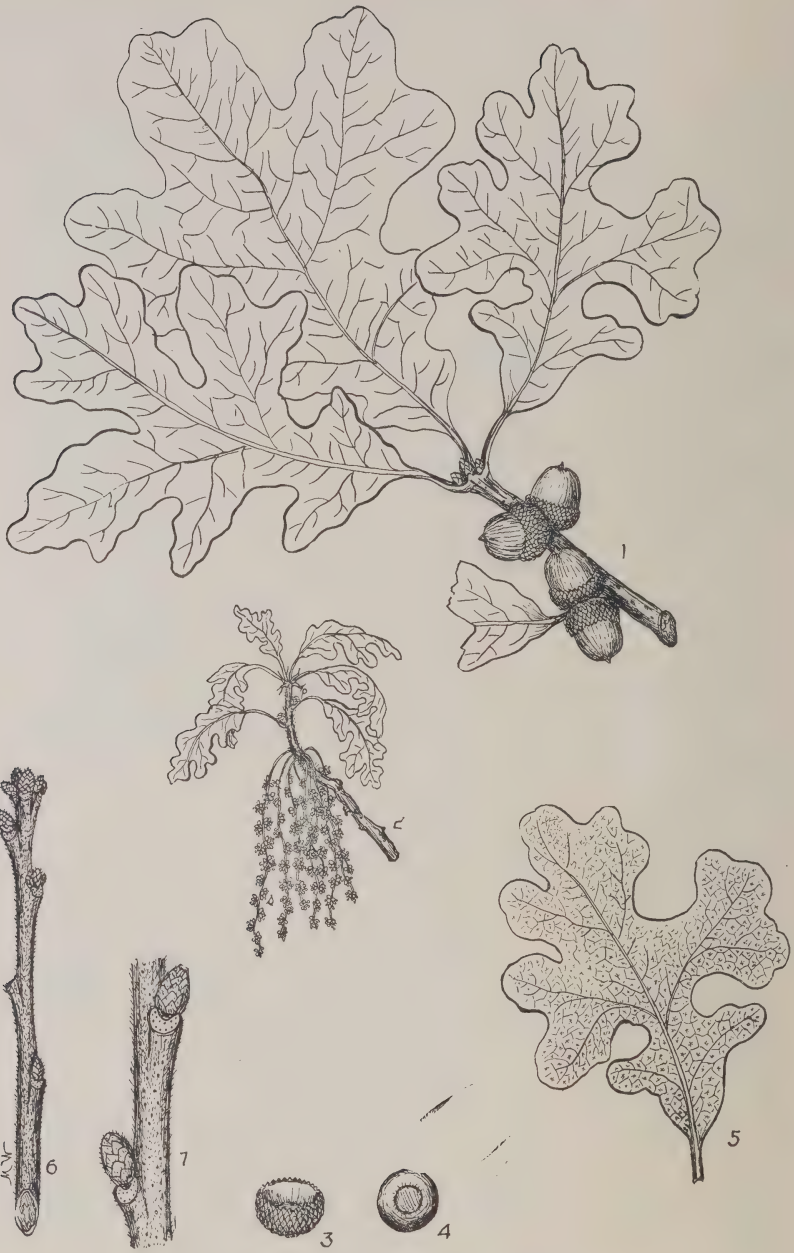

PLATE LVI. POST OAK

1. Branch with mature leaves and mature acorns, x ½.
2. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
3. An acorn cup, x ½.
4. An acorn, basal view, x ½.
5. Lower surface view of mature leaf showing the dense star-shaped pubescence, x ½.
6. Winter branch covered with a dense rusty pubescence, x ½.
7. Section of winter branch showing slightly pubescent buds, leaf-scars with bundle-scars, lenticels, and the dense rusty pubescent bark, natural size.

POST OAK

Quercus stellata, Wangenheim

FORM—A medium-sized tree, usually attaining height of 50-60 ft. but may reach a maximum height of 90 ft. with a diameter of 4 feet. In the open it forms a dense, broad, deep, round-topped crown with stout and spreading branches. Toward its northern limit it is a large shrub.

BARK—On trunks somewhat similar to that of White Oak only darker and often rougher and less scaly. On young branches it is often covered with loose, dark scales.

TWIGS—Stout, covered with yellowish rusty pubescence, at first light orange in color, later dark brown. Season's growth stands in strong contrast with later growth on account of much lighter color. Pubescence soon turns dark and finally disappears.

BUDS—Alternate, broadly ovate, about ⅛ of an inch long, sometimes as broad as long, blunt-pointed, covered with numerous overlapping, reddish-brown, slightly pubescent scales.

LEAVES—Alternate, simple, obovate in outline, 4-7 inches long, 3-5 inches wide, thick, leathery, generally 5-lobed; the middle pair of lobes is the largest and is separated by deep sinuses; upper surface is bright green, shiny; lower surface is paler and coated with rusty pubescence.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May. Staminate borne in slender aments 4-6 inches long. Pistillate are sessile or short-stalked, woolly; stigmas bright red.

FRUIT—An acorn, maturing at end of first season; usually sessile, occurs solitary, in pairs or clustered. Nut oval, ½-¾ of an inch long, hairy at apex, longitudinally striped with darker brown, inclosed by cup for ⅓-½ of its length. Cup thin, hairy within, and covered with thin, pale, flat wooly scales.

WOOD—Ring-porous; with conspicuous medullary rays; heavy, hard, close-grained, very durable, light to dark brown, with light sapwood. Weighs 52 lbs. per cubic foot. Used for the same purposes as White Oak. It is found on the market mixed with White Oak.

DISTINGUISHING CHARACTERISTICS—In summer the Post Oak, also known as Iron Oak, may at once be recognized by the peculiar form of its leaves, with large rounded or squarish lobes. The three terminal lobes are the largest and the basal lobes taken together are wedge-shaped in outline. The rigid leathery leaves with their shiny green upper surface and rusty pubescent lower surface, and the rusty pubescent twigs are characteristic. In winter its short obtuse buds and stout rusty pubescent twigs are distinctive. The buds have also a brighter reddish color than those of the White Oak.

RANGE—Massachusetts to central Pennsylvania, Kansas, and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally in the eastern and southern parts, but not in the western and northern. Near Mont Alto, Franklin county, it is locally common. A tree felled in 1912 about one-half mile south of this village measured over three feet breast-high.

HABITAT—Common on dry rocky soil. Found on gravelly uplands, limestone hills, and sandy plains.

IMPORTANCE OF THE SPECIES—The Post Oak closely resembles the White Oak, especially in the wood, which is sold as White Oak. On account of its limited distribution in Pennsylvania, and the superiority of the White Oak, the Post Oak cannot be recommended for forestry purposes on an extensive scale. It will, however, grow on poorer soil than the White Oak and might be established upon such areas. It is difficult to transplant and grows slowly.

BUR OAK

Quercus macrocarpa, Michaux

FORM—Usually attains height of about 70-80 feet but may reach a maximum height of 170 feet with a diameter of 6-7 feet. It attains its greatest height in Illinois and Indiana. It has broad spreading branches which form a broad round-topped crown. In the forest the crown is usually contracted and covers only the upper part of the trunk. It is a giant among its associates.

BARK—Intermediate between flaky bark of White Oak and very roughly ridged bark of Chestnut Oak.

TWIGS—Stout, covered with pale, raised and inconspicuous lenticels, yellowish-brown, at first hairy, later smooth, with corky wings often 1½ inches wide.

BUDS—Alternate, broadly-ovate, about ¼ of an inch long, acute or obtuse, reddish-brown, slightly pubescent. Lateral buds are closely appressed.

LEAVES—Alternate, simple, 6-12 inches long, 3-6 inches wide, obovate or oblong; 5-7 lobed; sinuses round-based; terminal lobe largest; smooth, shiny, and dark green above; paler and finely hairy beneath.

LEAF-SCARS—See "Leaf-Scars" under White Oak,, page 138.

FLOWERS—Mature about May. Staminate flowers borne in slender ament 4-6 inches long. Pistillate sessile or short-stalked, with bright red stigmas and hairy scales.

FRUIT—An acorn, maturing during first season; sessile or stalked, usually solitary. Nut ovate, 4/5-2 inches long, covered with down. Cut deep, embracing from ½ to entire nut, light brown, downy on inner side, covered with large imbricated scales forming a distinct fringe near the margin.

WOOD—Ring-porous; with conspicuous medullary rays; heavy, hard, strong, close-grained very durable, brownish with light thin sapwood. Weighs 46 lbs. per cubic foot. Used for the same purposes as White Oak from which it is not distinguished on the market.

DISTINGUISHING CHARACTERISTICS—In summer the Bur Oak, also known as Over-cup or Mossy-cup Oak, can be distinguished by its unique leaves, which have deep, rounded sinuses that reach almost to the midrib and divide each side of a leaf almost into two parts. The lobes on the front part are rather squarish and those on the basal part triangular. The pubescence on the lower side of the leaves and the corky winged projections on the branches are also characteristic. In winter the corky winged projections on the branches, the closely appressed and pubescent buds, the distinctly fringed acorn cups, and the persistent leaves are characteristic.

RANGE—Nova Scotia to Manitoba, south to Pennsylvania, Kansas and Texas.

DISTRIBUTION IN PENNSYLVANIA—Rare or local in the eastern, southern, central, and western parts of the State. Not reported from the northern part of the State. An unusually large specimen stands in a field near Petersburg, Huntingdon county. What is probably the largest oak in Pennsylvania is a Bur Oak. It stands near Neff's Mill in Huntingdon county. It is 39 feet and 9 inches in circumference at the ground, and at breast high it is almost 7 feet in diameter.

HABITAT—Prefers low rich bottomlands but can grow upon a variety of soils. It does not thrive on uplands so well as the White Oak, grows much slower than the Red Oak, and is rather intolerant of shade.

IMPORTANCE OF THE SPECIES—The Bur Oak is one of the very largest of American Oaks, has a wide distribution, and occurs in pure and in mixed stands. It produces valuable wood especially adapted to quarter-sawing on account of conspicuous medullary rays. It should be regenerated especially in the Mississippi basin where it develops at its optimum. This tree is also very attractive as an ornamental or shade tree, since it withstands smoke more than most other Oaks, and is relatively free from disease.

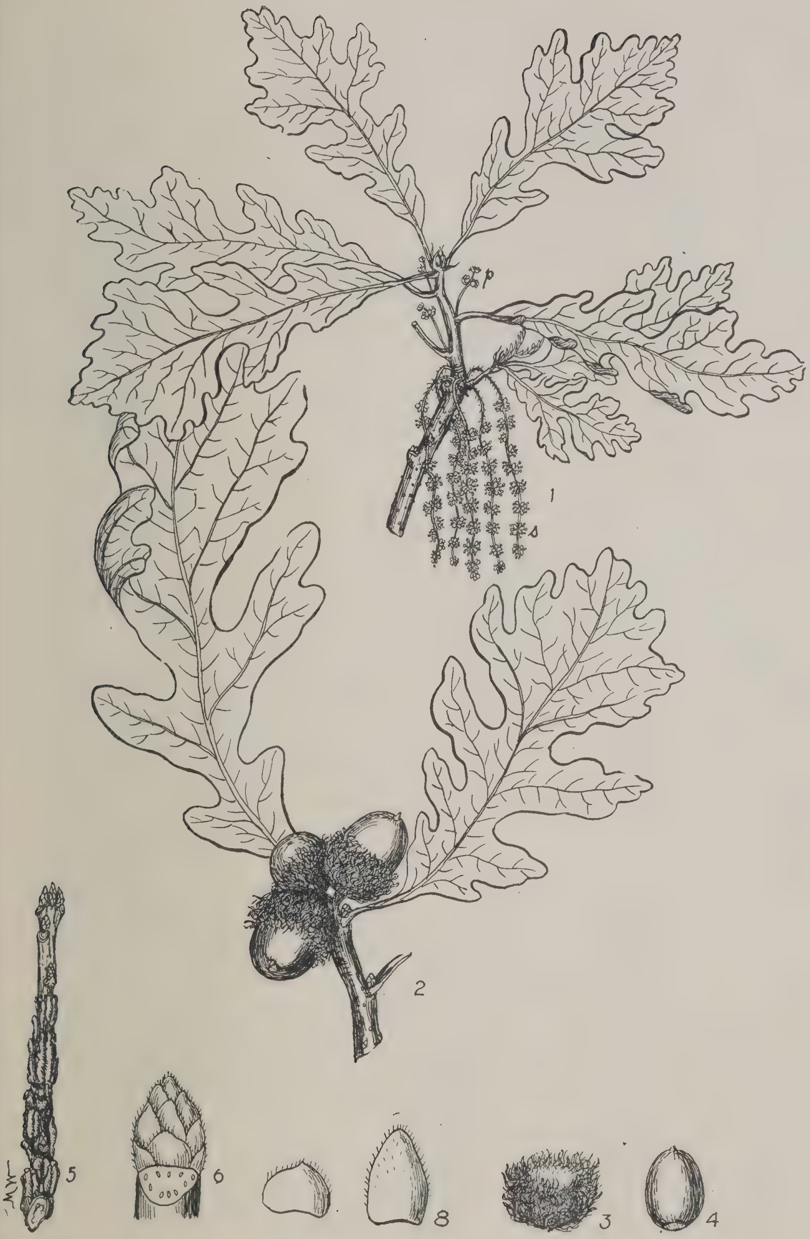

PLATE LVII. BUR OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. Branch with mature leaves and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. A winter branch showing buds, leaf-scars, and raised corky ridges, x ½.
6. Terminal section of winter branch showing buds with overlaping scales and leaf-scar with bundle-scars, enlarged.
7. Basal bud-scale with hairy margin, enlarged.
8. Apical bud-scale with hairy serrate margin, enlarged.

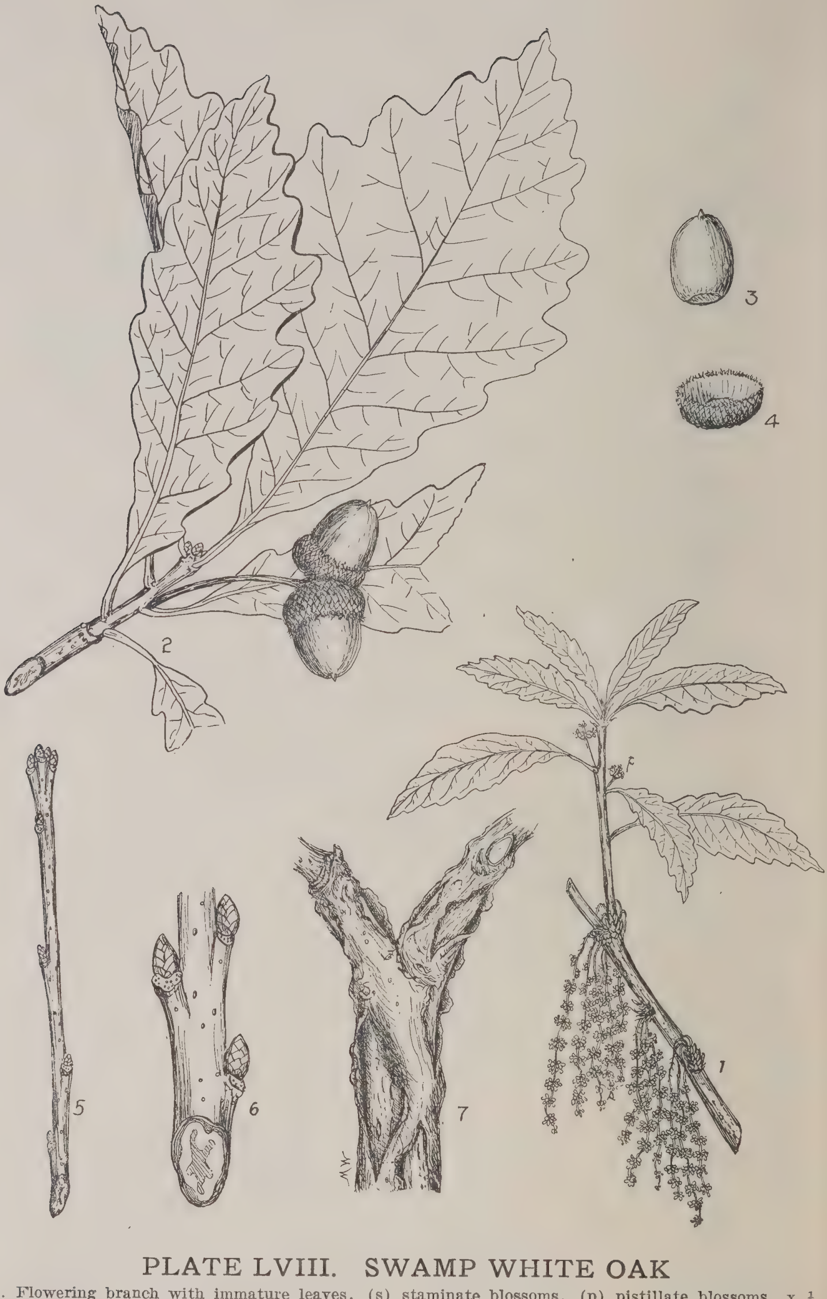

PLATE LVIII. SWAMP WHITE OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. Branch with mature leaves and mature long-stalked acorns, x ½.
3. An acorn, x ½.
4. An acorn cup, x ½.
5. A winter twig, x ½.
6. A winter twig with buds, lenticels, leaf-scars, and five-sided pith, enlarged.
7. Section of winter branch showing dark, broken, and scaly outer bark, enlarged.

SWAMP WHITE OAK

Quercus bicolor, Willdenow

FORM—An average-sized tree usually attaining a height of 60-70 ft., occasionally attaining a height of 100 ft. with a diameter of 3 feet. In the open it develops a broad, open, round-topped crown with the upper branches ascending, the lower often drooping. Scraggy and peeling branches make it rather unattractive. In dense stands the trunk is clean and continuous.

BARK—On young branches reddish-brown, smooth, soon becoming rough and unkempt by peeling into long, persistent, dark scales and exposing light inner bark. On old trunks, thick, grayish-brown, deeply fissured into long, often continuous, flat ridges which break up into small gray scales. See Fig. 96.

TWIGS—Stout, yellowish to reddish-brown, usually smooth, covered with pale raised lenticels; pith star-shaped.

BUDS—Alternate, broadly ovate, obtuse, ⅛-¼ of an inch long, covered with light chestnut-brown scales, often slightly hairy towards the apex.

LEAVES—Alternate, simple, usually obovate in outline, 5-6 inches long, 2-4 inches wide, rounded at narrowed apex, coarsely dentate on margin, with shallow rounded lobes; upper surface shining dark yellowish-green; lower surface light green and finely hairy.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate flowers occur in hairy aments 4-5 inches long. Pistillate are borne on short stalks, either solitary or few in a cluster.

FRUIT—An acorn, maturing during one season, solitary or few in a cluster, usually borne on a long stalk. Nut oblong, ¼-1¼ inches long, chestnut-brown, usually hairy at apex. Cup deeply saucer-shaped, thick, enclosing ⅓ of nut, hairy inside, covered with pale wooly scales which are rather thickened near base, and thin, often fringed at margin.

WOOD—Diffuse-porous; with rather conspicuous medullary rays. It possesses the same physical characteristics as the White Oak, and is sold on the market as White Oak. Weighs 48 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Swamp White Oak can be distinguished from all other Oaks at any season of the year by the bark on the younger branches which peels off into thin large plates as in the Buttonwood tree. In summer this species can be recognized by the leaves which have shallow sinuses between the lobes, giving the leaf a broad effect. In fall the long-stalked acorns with their cups enclosing about ⅓ of nut are characteristic. In winter the rather stout, yellowish to reddish-brown twigs bearing buds with light chestnut-brown scales and the irregular, often drooping, growth of the lower lateral branches is peculiar to this species.

RANGE—Maine and Quebec to Michigan, south to Georgia and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Reported from eight counties in the eastern and southern parts of the State, one in the western, one in the northeastern, and common in the northwestern part.

HABITAT—Frequents rich soils on borders of swamps and streams.

IMPORTANCE OF THE SPECIES—The Swamp White Oak is an important tree but its propagation should not be recommended or attempted where the White Oak will grow. Its lateral branches have a tendency to persist which results in an inferior grade of lumber. It has no ornamental qualities which especially recommend it for such planting.

YELLOW OAK

Quercus Muhlenbergii, Engelmann

FORM—An average-sized tree usually attaining a height of 40-50 fe., but occasionally may reach a height of 160 ft., with a diameter of 3-4 feet. Rather stunted in growth in the northeastern part of its distribution and attaining its maximum development along the Wabash river in Indiana and Illinois. Lateral branches are relatively small forming a narrow, often shallow, round-topped head. Trunk often widely buttressed at base.

BARK—Thick, rough, close, fissured into long, irregular ridges which break up into grayish to brownish scales.

TWIGS—Slender, reddish-brown to grayish-brown, at first hairy, becoming smooth, longitudinally ridged, covered with pale lenticels; pith star-shaped.

BUDS—Ovoid, sharp-pointed, about 1/6 of an inch long, covered by numerous overlapping, light chestnut-brown scales which are slightly hairy along margin. The buds show a general resemblance to those of the Chestnut Oak only are smaller.

LEAVES—Resemble those of the Chestnut Oak but have a more acuminate apex; also resemble those of the common Chestnut with incurved teeth.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate flowers occur in hairy aments, 3-4 inches long. Pistillate flowers sessile or short-stalked with bright red stigmas.

FRUIT—An acorn, maturing during one season, usually sessile, occasionally short-stalked. Nut ovoid, ½-1 inch long, pubescent at apex, light chestnut-brown. Cup thin, encloses about ½ of nut, covered by pale brown woolly scales with thickened bases and thin tips often forming a fringe along the margin.

WOOD—Diffuse-porous; with less prominent medullary rays than most Oaks; heavy, hard, strong, durable in contact with soil. A distinct difference between spring and summer wood. Used for same purpose as White Oak except for tight cooperage and cabinet work, because it checks very badly. Weighs 54 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Yellow Oak, also known as Chinquapin Oak, can be distinguished from the Chestnut Oak by its usually sessile and smaller acorns, smaller buds, more acuminate leaves, and flaky gray bark. It can also be distinguished from the Dwarf Chinquapin Oak by its larger size, sharp-pointed buds, larger and sharper-pointed leaves, and the absence of gray blotches on the bark of the young trunks.

RANGE—Vermont to Minnesota, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Rare. Found locally in the southeastern and southern parts. Also reported from Beaver and Lawrence counties, in the western part. It frequents the valleys more than the Chestnut Oak. It is common locally in the Cumberland Valley, especially near the streams.

HABITAT—Usually found on dry ridges, especially upon limestone soil.

IMPORTANCE OF THE SPECIES—The wood of Yellow Oak is not equal to that of the White Oak and in addition it grows slower. In all localities where both grow the White Oak should be favored, while in localities where the White Oak is absent this Oak might be propagated. It is a beautiful tree and should be planted extensively in parks and lawns on account of its handsome form and attractive foliage.

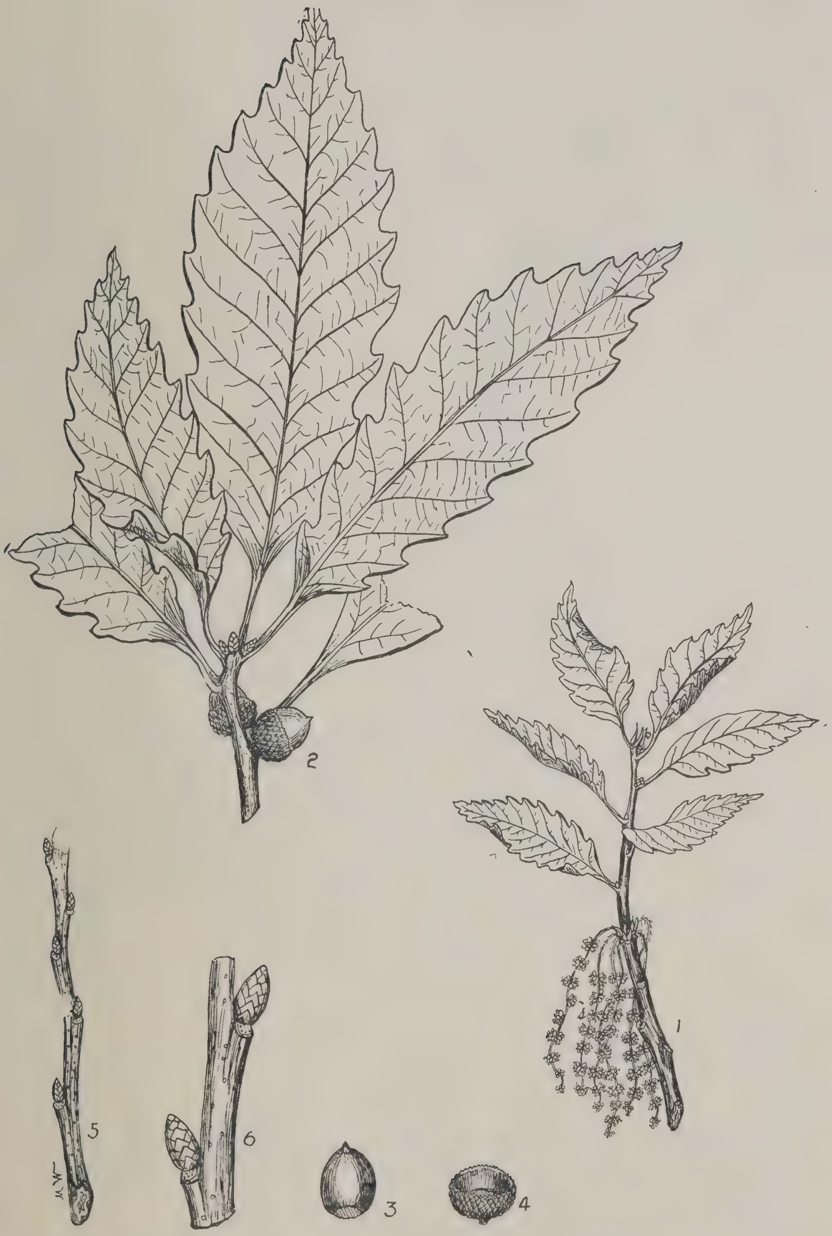

PLATE LIX. YELLOW OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. Branch with mature leaves and mature acorns, x ½.
3. An acorn, x ½.
4. An acorn cup, x ½.
5. Terminal section of winter twig, x ½.
6. Section of winter twig showing buds, lenticels, and leaf-scars with bundle-scars, enlarged.

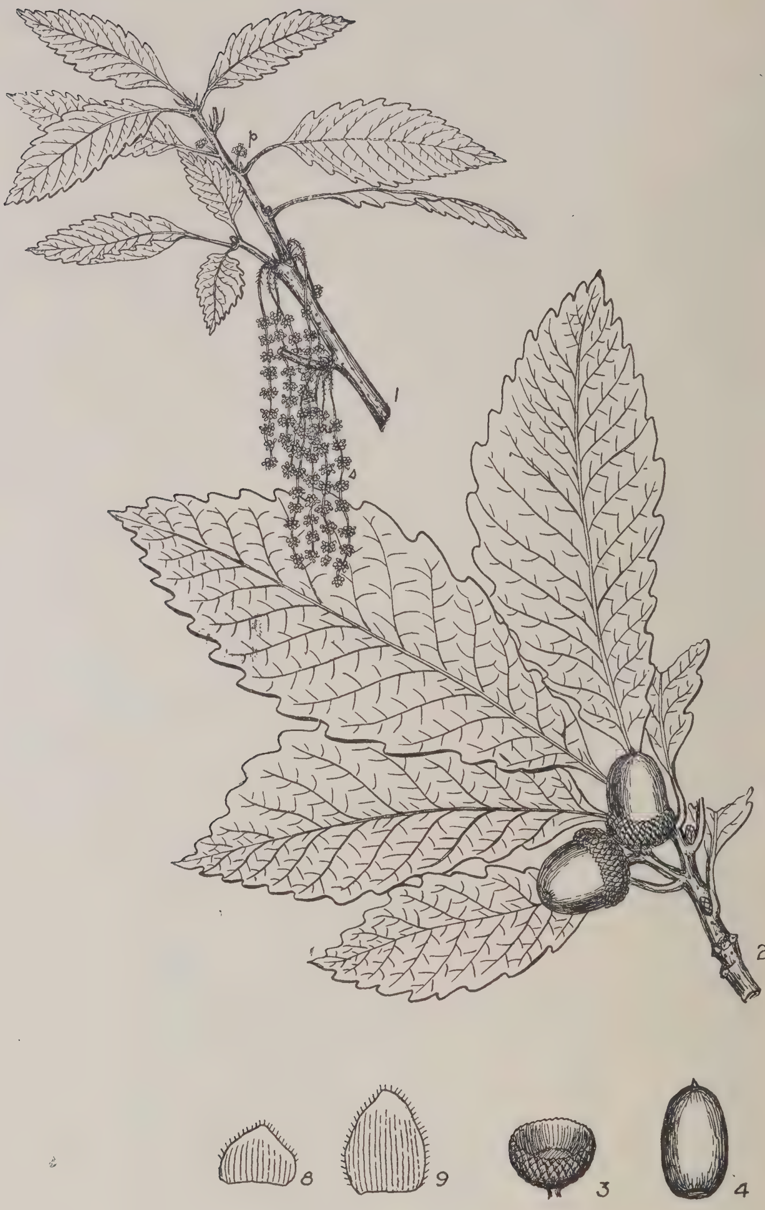

PLATE LX. CHESTNUT OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. Branch with mature leaves and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. A winter twig, showing buds, lenticels, leaf-scars, fluted bark, and pentangular pith, x ½.
6. Section of a winter twig, enlarged.
7. Cross-section of a twig showing pentangular pith, wood with conspicuous medullary rays, inner and outer bark, enlarged.
8. A basal bud-scale with hairy margin, enlarged.
9. An apical bud-scale with hairy margin, enlarged.

CHESTNUT OAK

Quercus Prinus, Linnaeus

FORM—A medium-sized tree usually attaining a height of 60-70 ft., occasionally 100 ft., with a diameter of 6-7 feet. In dense stands the trunk is straight and continuous while in open stands it is low and divided, forming a very broad open crown.

BARK—On young stems and smaller branches smooth, thin, yellowish-brown. On older branches and trunk rough, thick, brown to black, rich in tannin, divided into long, broad and continuous fissures. Ridges are very solid, sharp-angled, not scaly. Base of the fissures often cinnamon-red, especially on the larger branches and smaller trunks. See Fig. 94.

TWIGS—First summer greenish-purple; first winter orange or reddish-brown; stout, smooth; bitter; with inconspicuous lenticels and star-shaped pith.

BUDS—Alternate, ovate-conical, distinctly sharp-pointed, ¼-½ of an inch long. Bud-scales light chestnut-brown, imbricated, slightly hairy towards apex and along margin.

LEAVES—Alternate, simple, obovate, thick, stiff, 5-9 inches long, 2-4 inches wide, usually wedge-shaped at base, coarsely dentate with rounded teeth on margin; green and smooth on upper leaf-surface, pale green and at first hairy on lower.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate flowers are yellow and borne in hairy aments 2-3 inches long. Pistillate flowers have a short divergent, reddish style, and occur in small groups upon stout stalks.

FRUIT—Solitary or in pairs; matures in one season on short stalks. Nut 4/5-1½ inches long, 2-3 times as long as broad, smooth, glossy, oval, chestnut-brown, acute or round-pointed, and contains a sweet kernel. Cup thin, hemispheric, covers ⅓ of nut, hairy inside. Scales of cup are thin-tipped, reddish-brown, rather knobby near the base.

WOOD—Ring-porous; with prominent medullary rays; heavy, strong, close-grained, durable in contact with soil, dark brown with lighter sapwood. Weighs 46.73 lbs. per cubic foot. Used for railroad ties, fencing, fuel and construction. Ranks close to White Oak.

DISTINGUISHING CHARACTERISTICS—In summer the Chestnut Oak, also known as Rock Oak, can be distinguished by its oblong leaves margined with coarse rounded teeth and the roughly fissured and non-scaly bark. In winter one can readily recognize it by its characteristic bark, its sharp-pointed conical buds and its distinctive fruit. The persistent leaves often aid in recognizing it in winter, as well as the absence of 1-year old developing acorns. The slender, angular, orange-brown twigs terminated by a cluster of light brown sharp-pointed buds with a slight apical pubescence will always determine this species with certainty.

RANGE—Maine to Ontario, south to Alabama and Tennessee.

DISTRIBUTION IN PENNSYLVANIA—Common in the mountainous region of the State. Locally it is the prevailing tree.

HABITAT—Usually found on dry hillsides and towards the south in the mountains. It reaches its best development in the mountains of western North Carolina, eastern Tennessee and Kentucky upon rich moist soil. It is light-demanding and unless crowded will develop often into a crooked tree.

IMPORTANCE OF THE SPECIES—The Chestnut Oak belongs to the White Oak group. Its wood is used practically for the same purposes as that of the White Oak. The wood is valuable and in addition the bark is very valuable because it is richer in tannin than that of any other Oak. Large quantities of this bark are harvested annually at the present time in the southern Appalachians. This species deserves to be regenerated extensively, especially by natural seed regeneration methods and admixed with the well-known Chestnut. In case of artificial regeneration it may be advisable to sow the seeds rather than plant seedlings since this species is rather sensitive to transplanting.

SCRUB CHESTNUT OAK

Quercus prinoides, Willdenow

FORM—Usually a low shrub from 2-5 ft. high, but may attain a height of 18 ft. with a diameter of 4 inches. Usually occurs in clumps but may occur solitary.

BARK—Thin, bitter, light brown, marked with light gray blotches, at first smooth, but later when trunk reaches a diameter of 4 inches it becomes rough.

TWIGS—Smooth, slender, at first dark green and rusty-pubescent but later reddish-brown and smooth, marked with rather inconspicuous pale lenticels.

BUDS—Alternate, ovate, rounded at apex, light brown, covered with thin overlapping scales which are sometimes hairy on margin.

LEAVES—Alternate, simple, obovate, 3-6 inches long, 2-3 inches wide, covered beneath with pale tomentum, short and stout-petioled, margined with 3-7 rounded teeth on each margin and terminated with acute or acuminate apex.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate aments 1½-2½ inches long, yellow and somewhat hairy. Pistillate flowers are short-stalked and bear bright red pistils.

FRUIT—An acorn, maturing at end of first season; ½-⅞ of an inch long, sessile or short-stalked, often produced in great abundance, singly or in pairs. Nut oval, light chestnut-brown; when young striated with dark longitudinal lines; blunt-pointed, shiny except at apex where it is often covered with pale down. Kernel sweet and edible. Cup thin, rather deep, covers about ½of nut, pale woolly outside, downy inside. Scales are indistinct, thinner towards apex, often knobby or tumid towards base.

WOOD—Ring-porous; with conspicuous medullary rays. Commercially not important on account of small size. Locally used for fuel.

DISTINGUISHING CHARACTERISTICS—The Scrub Chestnut Oak, also known as Dwarf Chinquapin Oak, Chinquapin Oak and Scrub Oak, can readily be distinguished from most of the Oaks of Pennsylvania by its dwarf forms. It resembles the Bear Scrub Oak rather closely but can be distinguished from it by its round-lobed leaves, knobby acorn-scales, scaly and often gray-blotched bark on larger stems, and sweet kernel of the acorns. The young branches of this species are pubescent while those of the Scrub Oak are usually smooth. The buds are small and not so sharp-pointed as those of the Chestnut Oak and the Yellow Oak.

RANGE—Maine to North Carolina, west to Kansas and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally in the eastern, northeastern, southern, and central parts of the State. Also reported from Allegheny county. Common near Milford, Pike county.

HABITAT—Prefers dry woods, rocky slopes or sandy soils. Occasionally found in hillside pastures and moist woods.

IMPORTANCE OF THE SPECIES—The Scrub Chestnut Oak is so small in size that it has practically no commercial value. It is hardly more than a forest weed and should not be planted or protected except where it might be used as an advance growth.

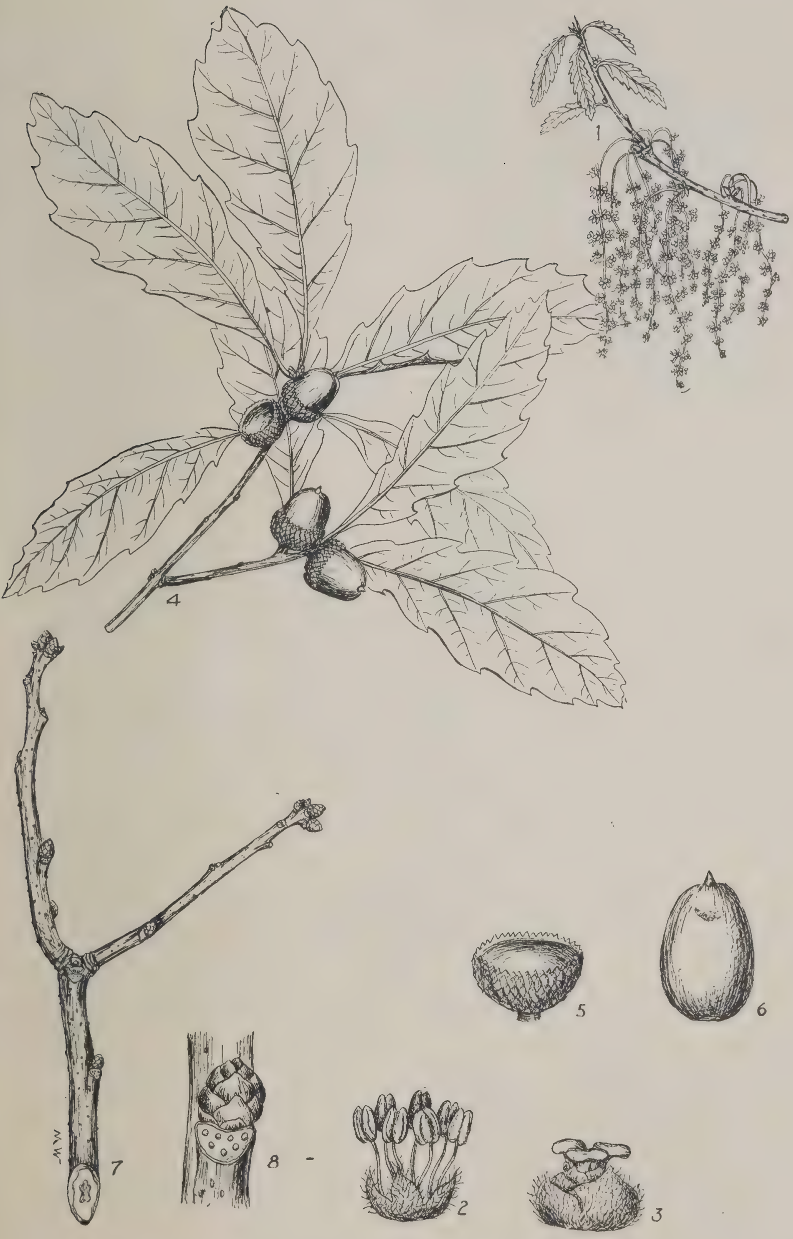

PLATE LXI. SCRUB CHESTNUT OAK

1. Flowering branch with immature leaves, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. A fruiting branch, x ½.
5. An acorn cup, x ½.
6. An acorn, x ½.
7. A winter twig, x ½.
8. Section of a winter twig, enlarged.

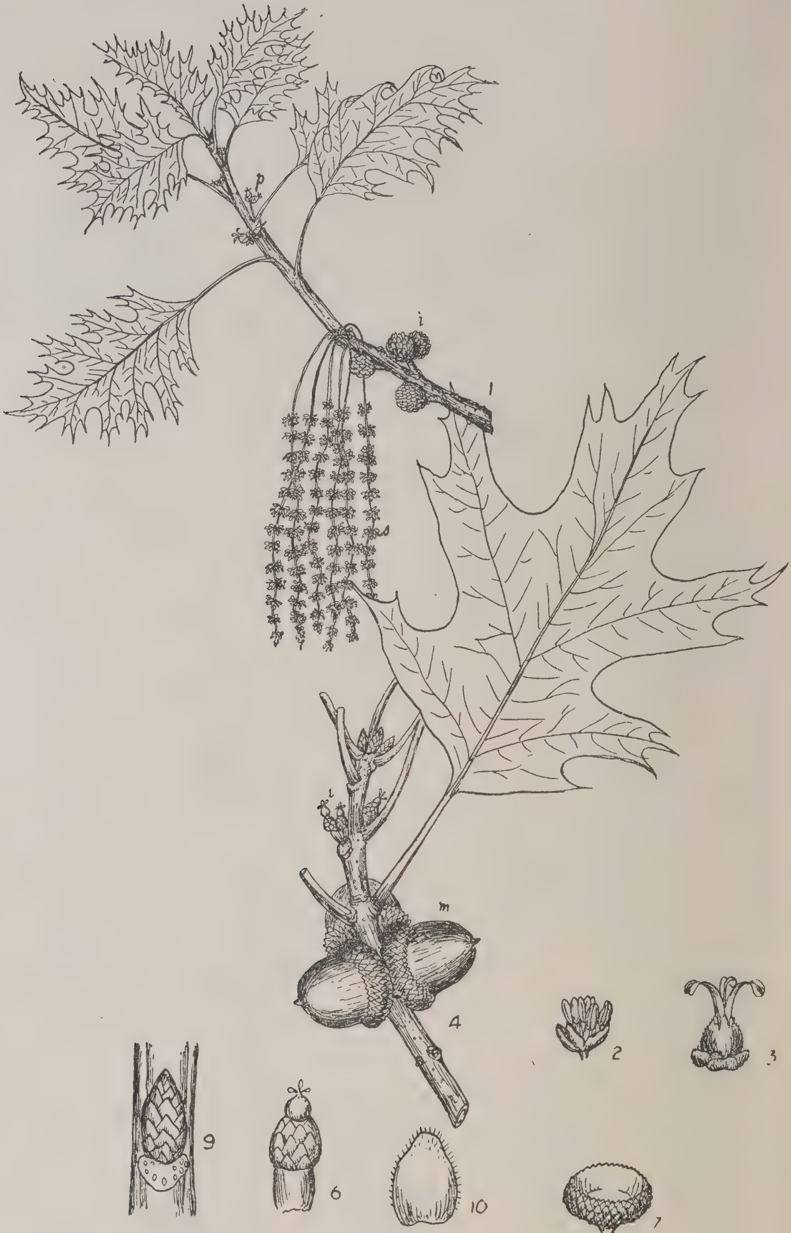

PLATE LXII. RED OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. Branch with mature leaves, (i) immature acorns, (m) mature acorns, x ½.
5. Winter twig with immature acorns, buds, and leaf-scars, x ½.
6. An immature acorn, enlarged.
7. An acorn cup, x ½.
8. An acorn, x ½.
9. Section of a twig, enlarged.
10. A bud-scale, enlarged.

RED OAK

Quercus rubra, Linnaeus

FORM—One of the largest forest trees of the Northern States, usually attaining a height of 70-90 ft. with a diameter of 2-4 ft. but occasionally reaching a height of 150 ft. with a diameter of 5 feet. When grown in the open has a short trunk and a broad symmetrical crown; in dense forest stands the trunk is straight, clean and continuous bearing a small, narrow crown. The straight ascending and clean branches of the crown are characteristic.

BARK—On young stems and branches smooth, gray to brown; on older trunks it is thick, slowly broken up by shallow fissures into regular, continuous, dark-brown and distinctly flat-topped ridges. Trunks above 3 ft. in diameter are often very rough near the base, having lost the characteristic flat-topped ridges which are, however, retained higher up on the stem. See Fig. 91.

TWIGS—Rather slender, smooth, greenish-brown to dark brown, covered with pale indistinct lenticels; pith star-shaped.

BUDS—Alternate, ovoid, 1/6-1/3 of an inch long, widest part near middle, narrowed upward to a sharp point, light brown, and free from woolly covering. Bud-scales numerous, overlapping, light brown, slightly longitudinally-striate, with slightly pubescent margins.

LEAVES—Alternate, simple oval to obovate in outline, 5-9 inches long, 4-6 inches wide, 7-9-lobed, with sinuses extending half-way to the midrib and separating ascending lobes with entire margin or few bristle-pointed teeth. Mature leaves firm, dull green, with yellowish to reddish midrib above and pale with a yellowish midrib below.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are about ½ developed. Staminate borne in slender, hairy aments, 4-5 inches long, with greenish 4-5-lobed calyx and 4-5 stamens terminated by yellow anthers. Pistillate borne on short stalks; involucral scales broadly ovate, blunt, pubescent; calyx lobes sharp-pointed; style spreading, recurved, light green.

FRUIT—An acorn, maturing at the end of second season, solitary or paired, short-stalked. Nut ovoid, ¾-1¼ inches long, flat at base, narrowed at apex. Cup is velvety on inside, broad, shallow, covering only base of nut, with closely imbricated, sometimes hairy, reddish-brown scales. Immature acorns usually divergent from twig, with basal scales reaching about ¾ of the way up, and appearing as if arranged in 3 rows.

WOOD—Ring-porous; with conspicuous medullary rays; heavy, strong, hard, close-grained, light reddish-brown, with thin lighter colored sapwood. Used for furniture, cooperage, construction, interior finish of houses, and railroad ties. Weighs 41 lbs. per cubic foot. The wood of Red Oak as well as that of the Black Oak and Scarlet Oak is coming more and more into use daily. The despised trees of to-day may be prized to-morrow.

DISTINGUISHING CHARACTERISTICS—The Red Oak may be recognized by its flat-topped ridges of the bark, its straight clean branches, its large dull green leaves with red midribs and ascending lobes with entire or few bristle-teeth, its light reddish inner bark, its glabrous, sharp-pointed, light brown buds which are often constricted at the base, and its large acorns with broad and shallow cups.

RANGE—Nova Scotia to Minnesota and Kansas, south to Florida and Texas. Planted extensively in Europe for ornamental and forestry purposes.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State. At its optimum in the Cumberland Valley and adjoining lower slopes. Rarer in the northern than in other parts of the State. It is one of the few oaks which occurs in the northern part of the State. What is probably the largest Red Oak in Pennsylvania stands in Guldin's Woods in Berks county. It is 63 inches in diameter at breast-high.

HABITAT—Prefers porous sandy or gravelly clay soil. It will not grow in wet soils and is also intolerant of shade, except when young.

IMPORTANCE OF THE SPECIES—The Red Oak is the most rapid growing species of all the Oaks. In one year it has grown to the height of 19 inches, in 10 years 18 feet, 20 years 33-39 feet, 50 years 50-57 feet. It deserves to be planted and regenerated naturally on an extensive scale. In a single small nursery the Pennsylvania Department of Forestry in 1911 raised over 200,000 Red Oak seedlings. A large number are being planted annually in all parts of the State. In Germany it has at present a wider distribution than any other American hardwood species. It is very attractive ornamentally on account of its smooth bark, straight branches, and the form and autumnal coloration of its leaves.

PIN OAK.

Quercus palustris, Muench

FORM—A medium-sized tree usually attaining a height of 50-60 ft. with a diameter of 2 ft., but may reach a maximum height of 120 ft. with a diameter of 3 feet. Trunk straight, usually clean, continuous, and bears a symmetrical conic crown. The lower lateral branches are short and drooping, the middle horizontal, and the upper ascending. The form of Pin Oak is very distinctive. See Figs. 57 and 58.

BARK—On old trunks relatively smooth but slightly roughened by shallow fissures separating low ridges which are covered by small close scales. On young trunks shining, very smooth, light brown to reddish. See Fig. 95.

TWIGS—Slender, tough, lustrous, at first hairy, later smooth, dark red to grayish-brown, covered with pale and inconspicuous lenticels.

BUDS—Alternate, smooth, ⅛ of an inch long, small, ovoid, sharp-pointed, covered with light brown scales which may sometimes be slightly hairy on the margin.

LEAVES—Alternate, simple, 4-6 inches long, 2-4 inches wide, ovate in outline, 5-9-lobed; lobes bristle-pointed, separated by broad deep and round-based sinuses. When full grown dark shining green above, pale green and smooth below, often with small tufts of hairs in the leaf axis.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate flowers occur in slender and hairy aments from 2-3 inches long. Pistillate are short-stalked and terminated by spreading bright red styles.

FRUIT—An acorn, maturing at the end of the second season, solitary or in pairs. Nut globose, light brown, often striped, about ½ of an inch long. Cup thin, saucer-shaped, shallow, ½ of an inch across, encloses only about 2/5 of nut, covered with thin closely overlapping scales. Kernel is bitter and pale yellow.

WOOD—Ring-porous; with conspicuous medullary rays; heavy, strong, hard, close-grained, checks and warps badly during seasoning. Weighs 43 lbs. per cubic foot. Used for cheap construction, cheap cooperage, railroad ties, and occasionally for interior finish.

DISTINGUISHING CHARACTERISTICS—The Pin Oak, also known as the Swamp Oak and Water Oak, when young and especially when open grown, can readily be recognized by its characteristic form. Its trunk is continuous, relatively smooth, and covered by many slender and rather short lateral branches which are drooping below, erect above, and horizontal in the middle. It frequents moist locations and bears small acorns with shallow cups. The branchlets are often beset with short, stiff lateral shoots which give it its common name. The buds are small, smooth, sharp-pointed, and light brown in color.

RANGE—From Massachusetts to Michigan and Missouri, south to Virginia, Tennessee, and Oklohoma.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southern parts. Occasional in the mountainous parts. Sparse in the western part.

HABITAT—It occurs in rich moist soil of river bottomlands, along streams, on border of swamps, and even thrives in fertile soil on the slopes and summits of the Allegheny mountains.

IMPORTANCE OF THE SPECIES—The Pin Oak does not rank high from a commercial point of view even among the Black Oak group of which it is a member. It is singularly beautiful for ornamental purposes. It deserves to be planted extensively as a shade, park, or avenue tree on account of its rapid growth, its beautiful form, and autumnal foliage, and the ease with which it is transplanted. Its commercial value, however does not recommend it for extensive planting for forestry purposes.

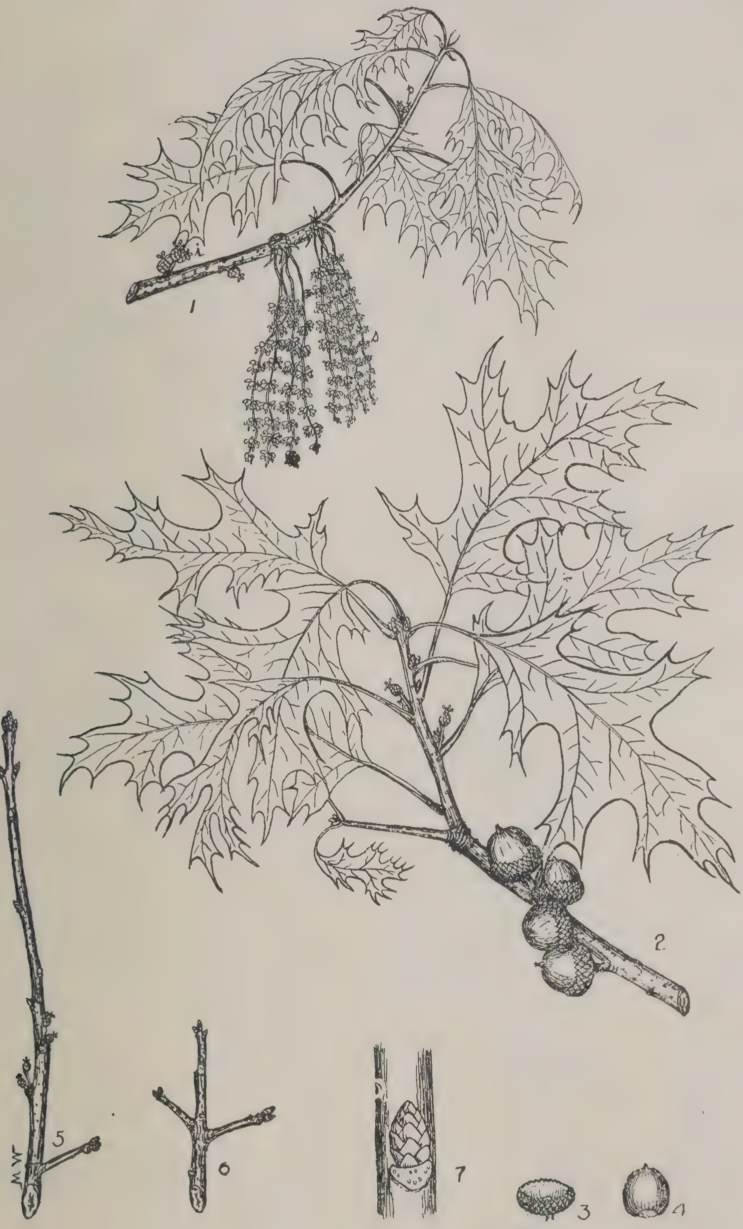

PLATE LXIII. PIN OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with immature acorns, buds, and one pin-like branchlet, x ½.
6. Winter branch with two pin-like branchlets, x ½.
7. Section of a winter branch, enlarged.

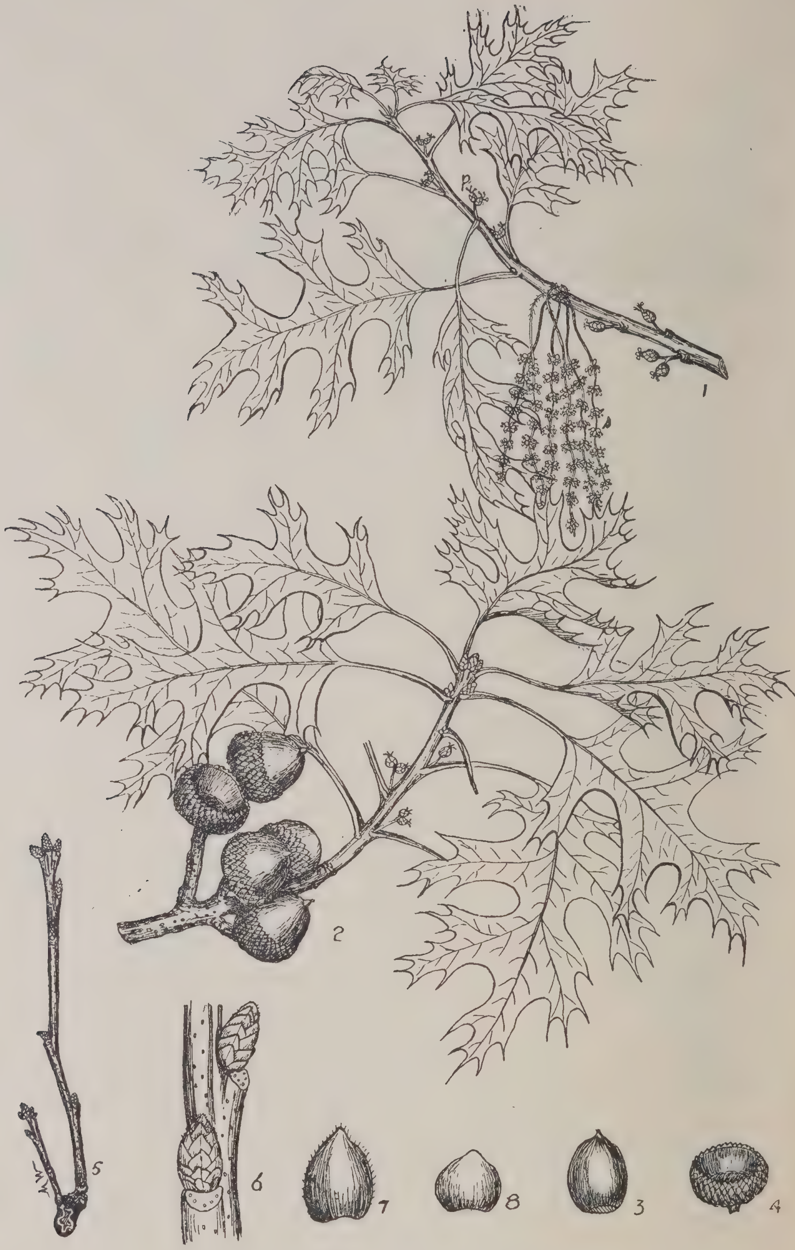

PLATE LXIV. SCARLET OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn, x ½.
4. An acorn cup, x ½.
5. Terminal section of a winter twig, x ½.
6. Section of a winter twig, showing lenticels, leaf-scars with bundle-scars, and two slightly angular buds covered with numerous overlapping scales, enlarged.
7. An apical bud-scale with ciliate margin, enlarged.
8. A basal bud-scale, enlarged.

SCARLET OAK

Quercus coccinea, Muench

FORM—An average-sized tree usually attaining a height of 60-80 ft., but occasionally reaching a height of 150 ft. with a diameter of 4 feet. Lateral branches ascending above, horizontal in middle, drooping below. Lateral branches are slender and lower ones die readily from shading, only persist for many years. Trunk very tapering, crown shallow and narrow.

BARK—On old trunks intermediate between the Red Oak and the Black Oak. It is broken up into rough, irregular, deep fissures which separate ridges not so rough as those of the Black Oak and not so flat-topped as those of the Red Oak. Inner bark red to gray. On younger limbs thin, smooth, light brown. See Fig. 97.

TWIGS—Slender, smooth, reddish or grayish-brown, covered with numerous, small, pale lenticels; pith star-shaped.

BUDS—Alternate, broadly ovate, narrowed to a blunt apex, ⅛-¼ of an inch long, dark reddish-brown, covered with a pale wool from the middle to the apex.

LEAVES—Alternate, simple, broadly oval to obovate, 3-6 inches long, 2½-5 inches wide, 5-9-lobed, lobes bristle-pointed and separated by deep round-based sinuses extending at least ⅔ of the distance to the midrib. In autumn brilliantly scarlet before falling.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate flowers are borne in slender pubescent aments 3-4 inches long. Pistillate on short pubescent stalks, reddish in color, with reflexed bright red stigmas.

FRUIT—An acorn, maturing at the end of the second season, sessile or short-stalked, solitary or paired. Nut ovoid, 2/5-4/5 of an inch long, reddish brown, occasionally striate. Cup thin, covering about ½ of the nut, narrowed at base, with closely imbricated, sharp-pointed, slightly downy scales often forming a fringe at the cup margin which is closely appressed to the nut.

WOOD—Ring-porous; with prominent medullary rays; strong, heavy, coarse in texture. Weighs 46 lbs. per cubic foot. The wood has little commercial value as timber.

DISTINGUISHING CHARACTERISTICS—The Scarlet Oak is one of the commonest of the Black Oak group and can readily be distinguished from the Black Oak by its smoother bark ridges on the trunk, its paler inner bark, its deeper round-based leaf-sinuses, its smooth, close-fitting scales of the acorn-cup, and its stouter, often smaller, less angular buds which are covered with pale wool only from the middle to the apex while the Black Oak is distinctly woolly over the entire bud. It can be distinguished from the Red Oak by its smaller and more deeply lobed leaves, its less flat-topped ridges of the bark, its smaller and deeper-cupped acorns, and its buds which are covered with a pale wool from the middle to the apex while those of the Red Oak are free from wool. The persistent, stunted, often drooping and dead lateral branches are also peculiar to this tree. This characteristic is common to trees on the border of bodies of water.

RANGE—Maine to Minnesota, south to North Carolina and Nebraska.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern, central, and southern parts. Sparse in western part. Rare in northern part.

HABITAT—Prefers dry sandy soil. Frequently met upon light stony or sandy uplands but the best individuals occur on good soil at the base of the slope where it is often found bordering hollows filled with water during spring.

IMPORTANCE OF THE SPECIES—The wood of the Scarlet Oak is of little commercial importance as compared with some of the other oaks. It is sold on the market as Red Oak but is inferior in quality to the latter. This tree is often attacked by fungi when it has reached medium size, which causes the wood to rot and often results in wind-break in the forest. On account of its fast growth, and beautiful foliage with its special autumnal coloration, it is regarded as one of the most desirable trees for street or park planting.

BLACK OAK

Quercus velutina, Lambert

FORM—One of the largest Oaks in Pennsylvania usually 60-80 ft. high, but may attain a maximum height of 150 ft. with a diameter of 4½ feet. Trunk usually clean and continuous giving off ascending branches above and horizontal ones below. Branches rather stout and zigzag. Crown deep, irregular, narrow to wide-spreading, oblong in outline.

BARK—On young stems smooth and dark brown, but soon becoming rough and black. On old trunks very rough, thick, broken into deep fissures separating thick ridges which are cross-fissured. Young trees, 2-4 niches in diameter often start to develop rough bark. Inner bark is yellow and bitter, a good distinguishing characteristic. See Fig. 93.

TWIGS—Stout, rusty-pubescent, reddish-brown, angular, longitudinally ridged from leaf-scars; taste bitter; covered by rather conspicuous pale lenticels.

BUDS—Alternate, ovate, large, ⅓-½ of an inch long, strongly angled, tapering to obtuse apex, covered with numerous overlapping bud-scales with a coating of yellowish to dirty-white pubescence.

LEAVES—Alternate, simple, obovate to oblong, 4-6 inches long, 3-4 inches wide, usually 7-lobed terminated by bristle points Mature leaves are dark green and smooth above and pale to yellowish-green below with tufts of rusty hairs in axil of veins at midrib. The leaves vary from those of the Red Oak. No other Oak produces so many differently shaped leaves on the same tree.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate flowers occur in hairy aments 4-6 inches long. Pistillate are borne on short hairy stalks.

FRUIT—An acorn, maturing during two seasons, sessile or stalked, solitary or clustered. Nut ovate to oval, ½-1 inch long, light reddish-brown, often coated with pubescence and longitudinally striate. Cup thin, tapering at base, dark reddish-brown, embracing ½ nut, covered with thin, light brown, sharp-pointed, hairy scales tightly overlapping at base and loosely overlapping at margin so as to form a fringe-like margin to the cup.

WOOD—Ring-porous; with conspicuous medullary rays; hard, heavy, strong, not tough, durable, checks readily. Heartwood is light brown, with lighter-colored sapwood. Weighs 44 lbs. per cubic foot. Used for furniture, interior finish, cheap cooperage, and ordinary construction. In general it finds the same uses as Red Oak.

DISTINGUISHING CHARACTERISTICS—The Black Oak is also known as Yellow Oak and Quercitron on account of its yellow inner bark. The dark colored and rough outer bark, even on young stems, and the yellow inner bark are at all seasons of the year definite marks of identification. The leaves, which vary from the shallow lobed ones similar to those of the Red Oak to the deep lobed ones similar to those of the Scarlet Oak, may also help to identify the species. No other Oak has so many varieties of leaves on the same tree as the Black Oak. In autumn the small acorns with the cup embracing one-half of the nut may also help to distinguish it from some species like the Red Oak and the Pin Oak. The large, angular buds covered over the whole surface with a pale wool are sure characteristics.

RANGE—Maine to Western Ontario, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern, central, and southern parts. Sparse in western part. Rare in the northern part. Only one specimen of this tree known to occur near Hull, Potter county.

HABITAT—Usually found on dry uplands, gravelly plains and ridges, especially in the Appalachian foothills. Seldom found in rich bottomlands. In the west usually found on sterile, sandy, or glaciated hills.

IMPORTANCE OF THE SPECIES—The Black Oak should be propagated only where no better trees can be grown. If its reproduction is thought desirable it should be attempted by natural seed regeneration or planting of seeds since planting of young seedlings from the nursery is expensive and success doubtful. Formerly the yellow inner bark was in demand because an extract in the form of a yellow dye, known as "Quercitron," was obtained from it. The introduction of analine dyes has decreased the demand. The Black Oak is not attractive as an ornamental tree.

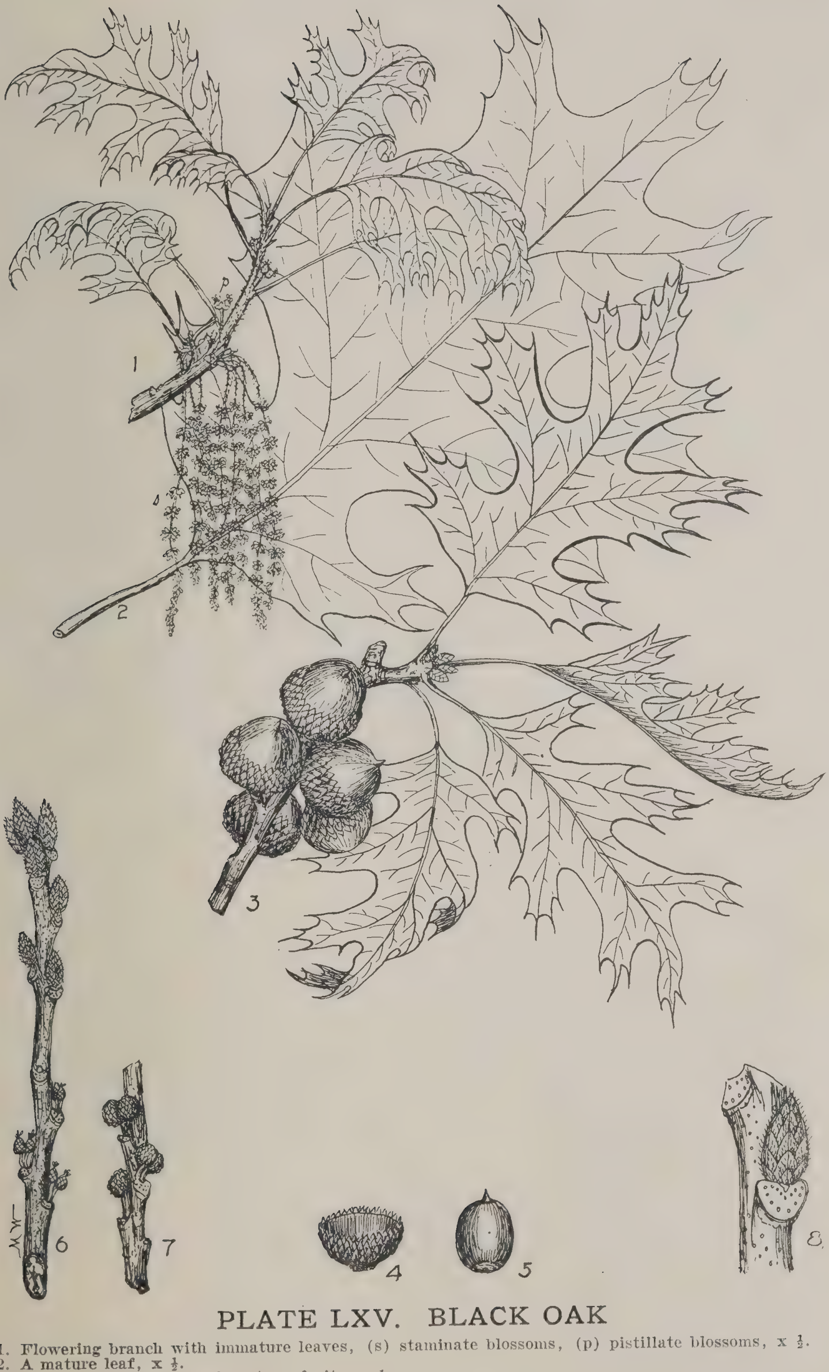

PLATE LXV. BLACK OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. A mature leaf, x ½.
3. Branch with leaves and mature fruit, x ½.
4. An acorn cup, x ½.
5. An acorn, x ½.
6. Winter twig with buds, leaf-scars, and immature acorns, x ½.
7. Section of twig with immature acorns, x ½.
8. Section of winter twig showing the large, angular and pubescent bud and leaf-scars with bundle-scars, enlarged.

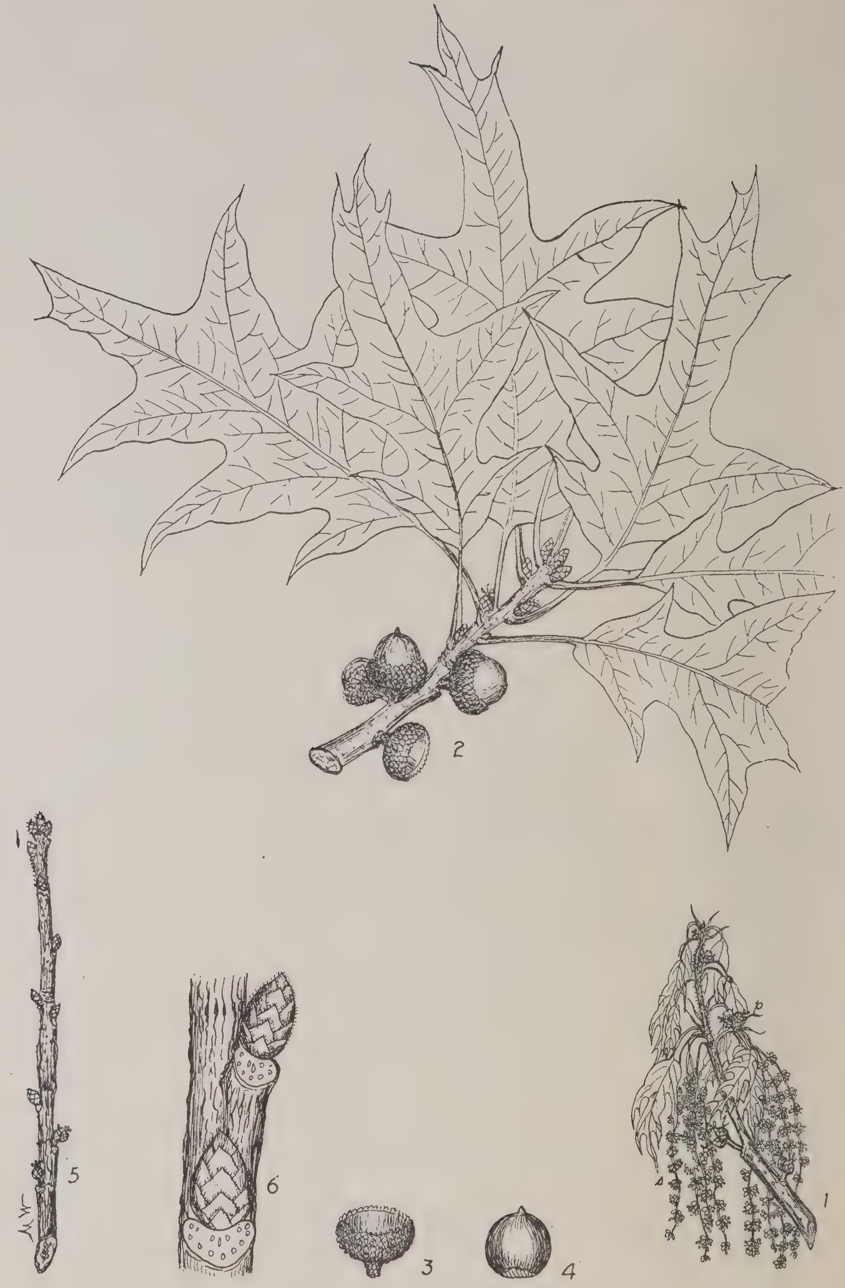

PLATE LXVI. SPANISH OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with immature acorns, buds, and leaf-scars, x ½.
6. Section of a winter twig showing buds, leaf-scars, and bundle-scars, enlarged.

SPANISH OAK

Quercus falcata, Michaux

FORM—A medium-sized tree usually attaining a height of 70-80 ft. with a diameter of 2-3 ft. but which may reach a maximum height of 120 ft. with a diameter of 4½ feet. Crown open, broad, round-topped, rather deep.

BARK—On old trunks divided by shallow fissures which separate low, brown, scaly ridges. On young parts thin, smooth, dark reddish-brown to gray and rich in tannic acid.

TWIGS—Stout, at first covered with rusty hairs, later almost smooth and reddish-brown to ashy-gray.

BUDS—Alternate, ovoid, sharp-pointed, ⅛ of an inch long, bright chestnut-brown, hairy.

LEAVES—Alternate, simple, 6-7 inches long, 4-5 inches broad, ovate in outline, 3-7 lobed; lobes bristle-pointed and separated by broad variable sinuses. They are dark green and shining above, covered with grayish down beneath. The leaves are very variable in outline.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Flowers appear in April or May when the leaves are about ⅓ developed. Staminate flowers are borne in slender hairy aments about 3-5 inches long. Pistillate on stout hairy stalks and terminated by rather short, divergent, dark red styles.

FRUIT—An acorn, maturing at the end of the second season; short-stalked. Nut ovoid to globose, rounded at apex, about ½ of an inch long, pale orange-brown, enclosed only at base for ¼ length. Cup hemispheric, ½-¾ of an inch across, covered by thin reddish scales which are pale pubescent especially on the margins.

WOOD—Ring-porous; with conspicuous medullary rays, hard, strong, not durable, with light red heartwood, lighter sapwood. It warps and checks badly. Weighs 43 lbs. per cubic foot. Largely used for fuel and also used in construction. Bark is rich in tannin.

DISTINGUISHING CHARACTERISTICS—The Spanish Oak bears leaves which resemble those of the Scrub Oak, only that the lobes of the latter are usually short and triangular while those of the former are mostly long and lanceolate. The Scrub Oak attains the height of a small tree only, while the Spanish Oak may reach a height of 100 feet. It can be distinguished from the other closely related members of the Black Oak group in this State by its white or grayish-tomentose coating on the lower leaf surface.

RANGE—New Jersey and southeastern Pennsylvania to Missouri, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Reported only from the southeastern and southern parts of the State. A fine grove occurs on Militia Hill, Montgomery county. Also reported from Berks, Chester, Delaware, Franklin, Lancaster and Philadelphia counties.

HABITAT—It is usually found on dry gravelly or sandy soil. In the South it is common between the Costal Plain and the Appalachian mountains.

IMPORTANCE OF THE SPECIES—Since the natural distribution in this State is limited to a few local places in the southeastern and southern parts and on account of its inferior wood, it cannot be recommended for forestry purposes. Other more valuable trees should be propagated. It is rather attractive as an ornamental tree and its bark is rich in tannin.

SCRUB OAK

Quercus ilicifolia, Wangenheim

FORM—Shrub or small tree with many crooked intertwined branches: usually 4-8 ft. high with a diameter of 1-3 inches, but occasionally attaining a height of 18-20 feet. See Fig. 4.

BARK—Thin, smooth, becoming scaly on older stems, gray to dark brown in color.

TWIGS—When young slender, dark green, tinged with red, and tomentose; becoming gray to reddish-brown, finally dark brown and smooth.

BUDS—Alternate, ovate, obtuse, ⅛ of an inch long, chestnut-brown: covered by numerous small dark-margined closely appressed scales.

LEAVES—Alternate, simple, 2-5 inches long, 1½-3 inches wide, obovate in outline, with a wedge-shaped base, 3-7 lobed, usually 5; with shallow sinuses and acute and bristle-tipped lobes. Mature leaves dark green and glossy above, covered with a dense whitish pubescence beneath, thick and leathery in texture, with conspicuous yellow midribs and veins. Petioles round, tomentose and about 1 inch long.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate aments 4-5 inches long, often clinging to twigs until late summer. Pistillate flowers borne upon stout tomentose stalks, have an involucre of red scales, and red stigmas.

FRUIT—An acorn, maturing at end of second season, very abundant, sessile or nearly so, usually clustered, seldom solitary. Nut broadly ovoid, with a flat rounded base, acute or rounded apex, about half enclosed in the cup, light brown, shiny and often slightly striate, ½ of an inch broad and long. Cup pale and reddish-brown and soft downy within, covered on the outside with many closely set reddish-brown scales whose free tips form a fringe around the edge of the cup. Kernel bright yellow.

WOOD—Ring-porous; with conspicuous medullary rays: pale brown, strong, hard, tough, and fine-grained. Commercially not important on account of its small size. Locally used for fuel.

DISTINGUISHING CHARACTERISTICS—The Scrub Oak, also known as Bear Oak and Ground Oak, can easily be distinguished by characteristic bristle-pointed leaves shown on the opposite plate, which turn reddish-brown or brown in autumn, and often persist throughout the winter. It is small in size and forms dense thickets over large areas, especially recently burned areas. The smooth non-scaly bark, persistent clusters of fruit and the small, brown, bluntly conical buds covered with slight pubescence are characteristic. In habit it resembles the Scrub Chestnut Oak, but the latter has a flaky bark round-lobed leaves and characteristic fruit.

RANGE—Maine to Ohio, south to North Carolina and Kentucky.

DISTRIBUTION IN PENNSYLVANIA—Common in most of the counties in and east of the Allegheny Mountains. Found in some of the counties in the southwestern portion of the State. Sparse in the north-central and northern parts. Only one specimen known to occur near Hull, Potter county. It is generally absent or rare in the northern tier of counties, i. e., in McKean, Potter and Tioga counties. In fact, it is rare or absent north of a line passing east-west through the center of Cameron county.

HABITAT—Usually found on rocky hillsides, sandy plateaus, and mountain tops. It is gregarious and able to flourish upon barren, dry, infertile soils, but cannot endure much shading, hence it seldom occurs in mixture with other species. It has overgrown extensive areas of burnt-over land in this State.

IMPORTANCE OF THE SPECIES—The Scrub Oak is of no commercial value but is economically important on account of its ability to grow upon the most exposed and inhospitable situations. This makes it worthy of consideration in protection forests, where it shelters the forest-floor, prevents erosion and enriches the soil wth accumulations of humus. In time it is usually displaced by trees of greater commercial importance as Chestnut, Scarlet Oak, Chestnut Oak, Maple, and Aspen. Areas once covered with thickets of Scrub Oak now often have only a few single representatives left,

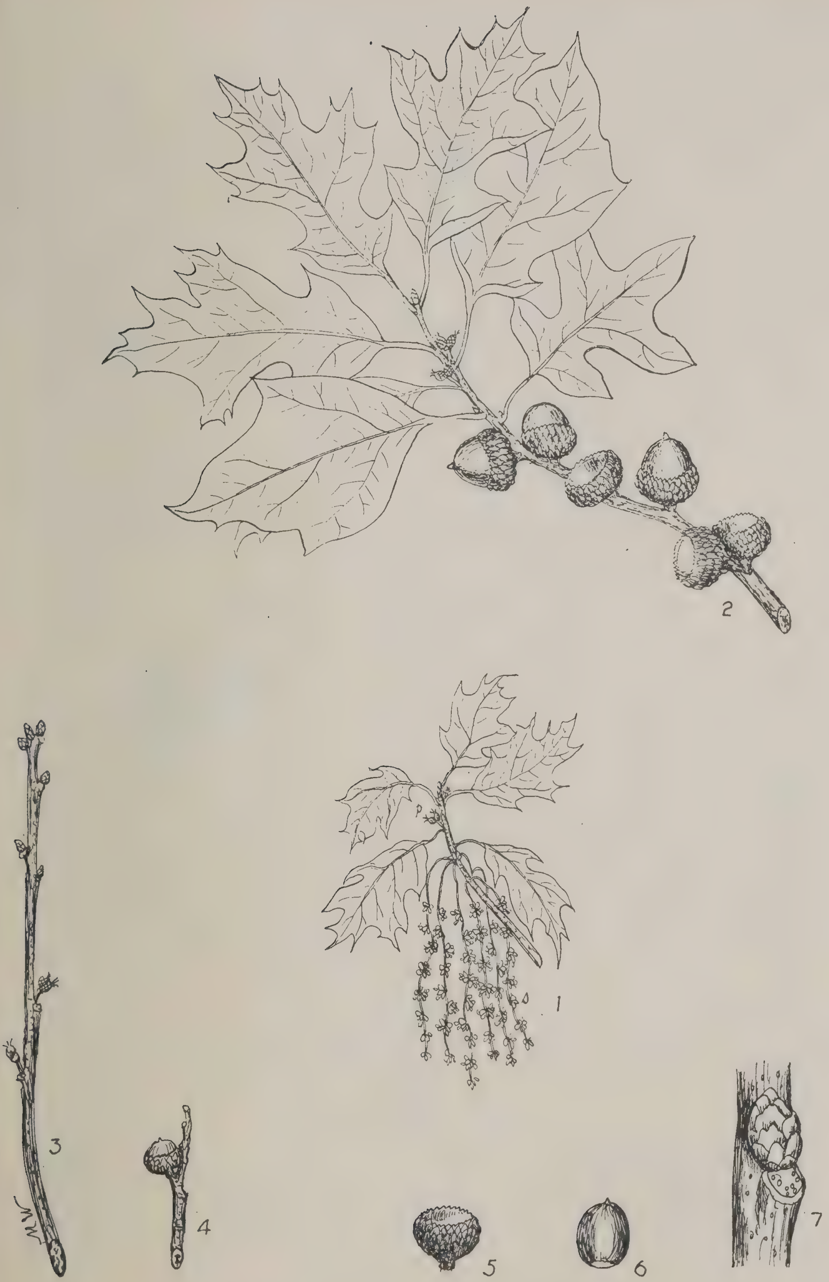

PLATE LXVII. SCRUB OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. Terminal section of a winter twig, x ½.
4. Winter twig with an acorn, x ½.
5. An acorn cup, x ½.
6. An acorn, x ½.
7. Section of a winter twig showing a leaf-scar with bundle-scars, lenticels, and a bud with numerous overlapping scales, enlarged.

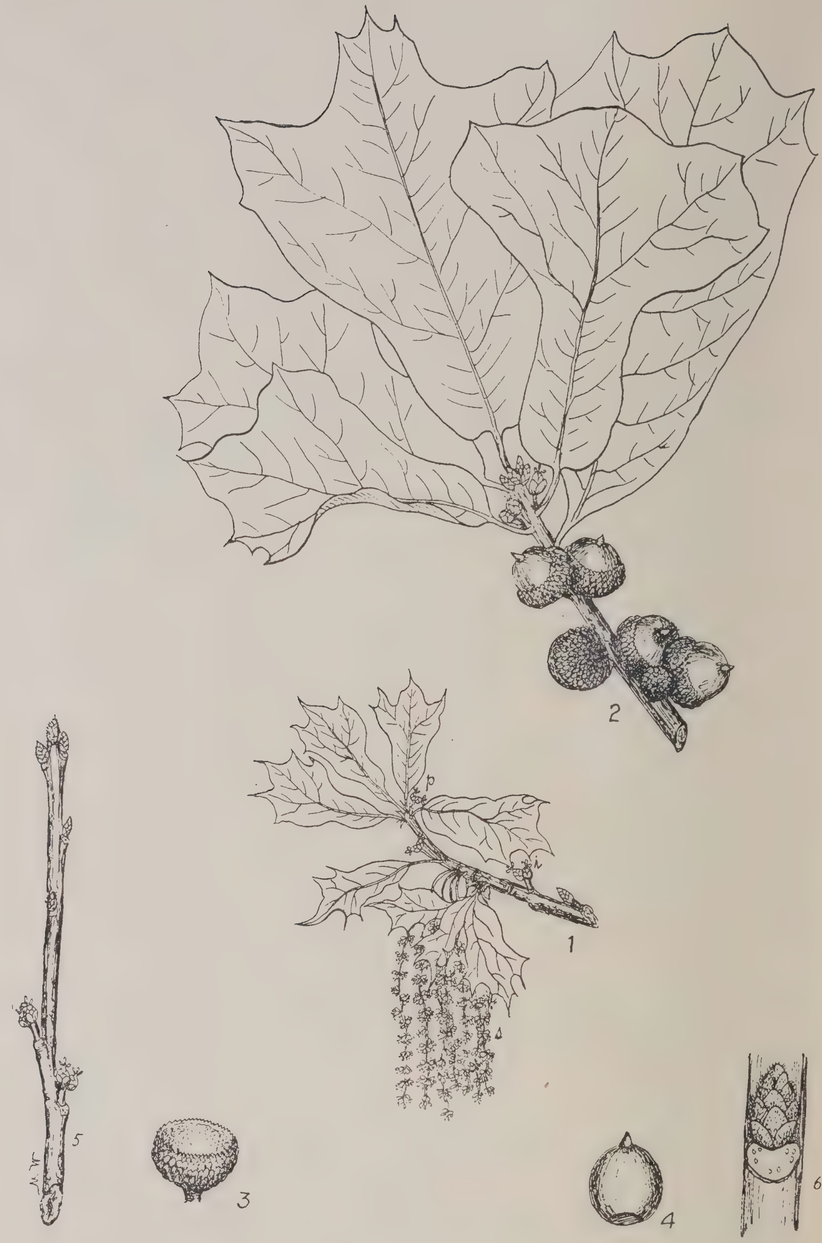

PLATE LXVIII. BLACK JACK OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with immature acorns, buds, and leaf-scars, x ½.
6. Section of a winter twig, enlarged.

BLACK JACK OAK

Quercus marilandica, Muench

FORM—This tree usually attains a height of 20-30 ft. with a diameter of 18 inches, but may reach a height of 60 ft. with a diameter of 3 feet. It reaches its maximum size in Texas and Arkansas. Crown usually compact, round-topped, and narrow on account of short branches. Upper branches are ascending, lower ones spreading.

BARK—Thick, roughened by deep fissures which separate broad angular plates covered with dark brown to nearly black scales.

TWIGS—Stout, coated at first with pale woolly covering of hairs, later becoming smooth and dark brown to gray.

BUDS—Alternate, ovate, distinctly angular; sharp-pointed, ¼ of an inch long, reddish-brown and rusty pubescent.

LEAVES—Alternate, simple, broadly ovate in outline, 6-7 inches long with an almost equal width, rounded or heart-shaped at the base, 3-5 lobed. Mature leaves deep green, thick, leathery, and smooth above; often rusty brown below.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when the leaves are ⅓ developed. Staminate flowers in slender, often persistent aments 2-4 inches long. Pistillate flowers on short, stout, pubescent stalks.

FRUIT—An acorn, maturing at the end of the second season, solitary or paired, short stalked. Nut ovoid, ¼ of an inch long, nearly same width throughout, often striate, light brown. Cup hemispheric, deep, covers one-half or over of nut, light brown and downy on inside, covered by large reddish brown, loosely overlapping scales. Small scales form a thin rim around the margin.

WOOD—Ring-porous; with conspicuous medullary rays; dark brown, heavy, hard, strong. Weighs 46 lbs. per cubic foot. Used for fuel, charcoal, and manufactured into lumber to a limited extent.

DISTINGUISHING CHARACTERISTICS—The Black Jack Oak, also known as Jack Oak and Barren Oak, can be distinguished by the large obovate leaves which are usually 3-5-lobed above the middle, or sometimes entire and covered with rusty brown pubescence. It is the only Oak of Pennsylvania which has its leaves dilated near apex. Its sharp-pointed, distinctly angular and somewhat hairy bud and its hemispheric acorn cup also aid in distinguishing it from the other closely related species.

RANGE—New York and Pennsylvania west to Nebraska and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Occasional in the eastern and southern parts of the State and a few local outposts in the western part. Common on Mount Penn, near Reading, Berks county. Also reported from Berks, Bucks, Delaware, Chester, Crawford, Lancaster, Montgomery, and Northampton counties.

HABITAT—Usually found on poor, dry, sterile, sandy soil, but in the South it is also found on clay. It reaches its best development upon the rich soil in the southern part of its distribution.

IMPORTANCE OF THE SPECIES—In the North the Black Jack Oak is a shrub only, or a small tree of no commercial importance, while in the South it becomes somewhat larger and is used for fuel, charcoal and lumber. In Pennsylvania it is of no forestal importance, but is a very attractive tree for ornamental purposes on account of its compact and deep crown.

LAUREL OAK

Quercus imbricaria, Michaux

FORM—A tree usually attaining a height of 50-60 ft. but may reach a height of 100 ft. with a diameter of 3 feet. Crown in mature trees rather open, often shallow, while in younger specimens it is pyramidal, rather closed, and the lateral drooping branches often touch the ground.

BARK—Up to 1½ inches in thickness, roughened by shallow fissures which separate ridges covered by close light brown scales. On younger stems, thin, often smooth and shiny.

TWIGS—Slender, at first dark green and lustrous; later light brown to dark brown.

BUDS—Alternate, ovate, sharp-pointed, slightly angular, ⅛ of an inch long and covered with numerous close-fitting, overlapping, erose, chestnut-brown scales with serrate margins.

LEAVES—Alternate, oblong to lanceolate, 4-6 inches long, 1-2 inches wide, wedge-shaped or round at the base, acute at apex, with usually entire or undulate margins. Mature leaves are thin, dark and shiny above; pale green and hairy below.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate flowers in hairy aments 2-3 inches long. Pistillate on short stalks above staminate.

FRUIT—An acorn, maturing at the end of the second season, solitary or in pairs, stalked. Nut ovoid ½-⅓ of an inch long, dark brown. Cup embraces almost ½ of nut, saucer-shaped, brown and shining inside, covered by numerous, closely overlapping, reddish-brown, hairy scales.

WOOD—Ring-porous; with conspicuous medullary rays; hard, coarse-grained, reddish-brown. It checks easily and consequently finds a limited use, in construction work. Weighs 47 lbs. per cubic foot. Used for fuel, charcoal, shingles, and manufactured into lumber.

DISTINGUISHING CHARACTERISTICS—The Laurel Oak, also known as Shingle Oak, Jack Oak, and Water Oak, may readily be distinguished from all other Oaks of Pennsylvania except the Willow Oak, by its characteristic leaf. The Willow Oak is smaller, has narrower and sharper-pointed leaves which are not hairy beneath. The leaves of this species are hairy beneath. The acorns are larger and the cups not so flat as those of the Willow Oak. The winter buds of the Laurel Oak are light chestnut-brown and somewhat angular, while those of the Willow Oak are dark chestnut-brown.

RANGE—Pennsylvania to Michigan and Nebraska, south to Georgia and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Found locally west of the Alleghenies. Occurs in Lehigh, Huntingdon, Franklin, Bedford, Westmoreland, Greene, Clarion, Indiana, Butler, Washington, Mercer, Venango, Lawrence, Clearfield, Beaver, Union, Fayette, Somerset, and Allegheny counties.

HABITAT—It occurs in rich bottomlands, often near streams, and also in rather moist fertile uplands.

IMPORTANCE OF THE SPECIES—The Laurel Oak reaches dimensions so that it can produce lumber of commercial size and quantity, but other superior species will grow in the same place and consequently it cannot be recommended for forestry purposes. It is, however, one of the most attractive ornamental Oaks and deserves to be planted extensively for such purposes.

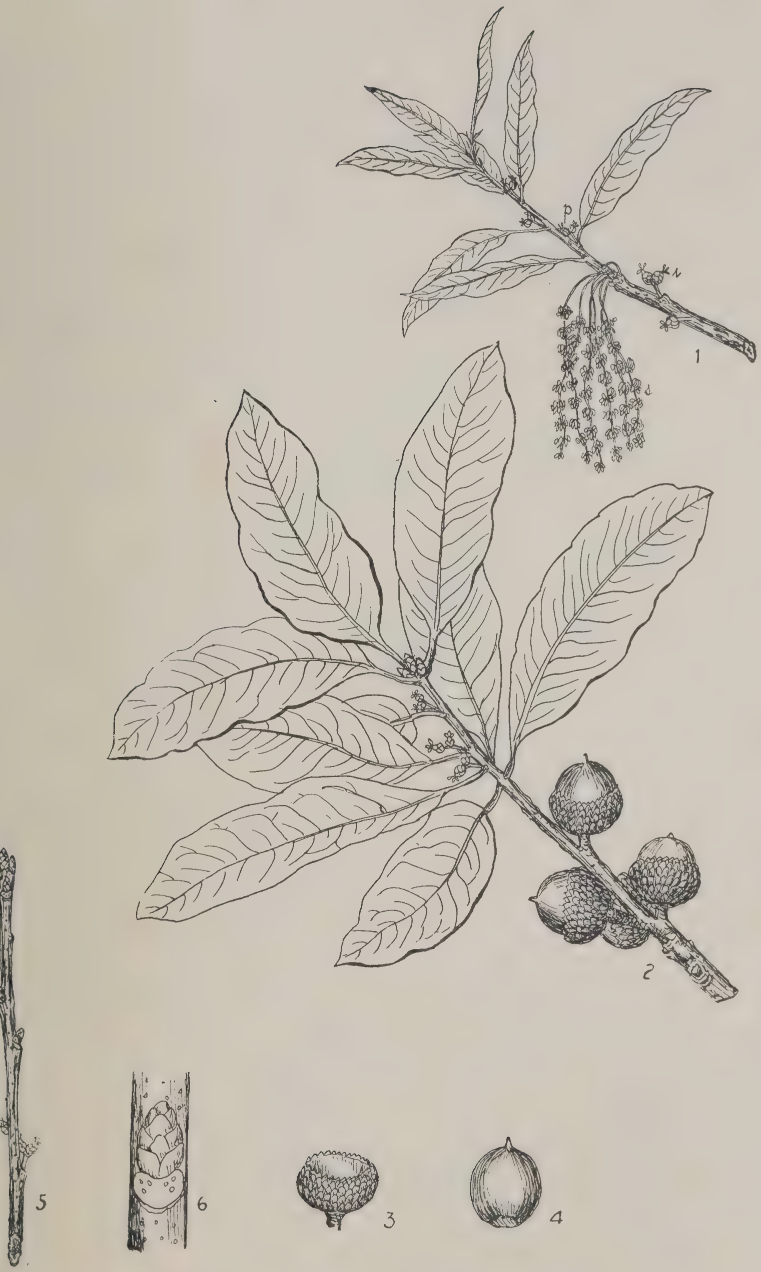

PLATE LXIX. LAUREL OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with buds, lenticels, pentangular pith, and immature acorns, x ½.
6. Section of a winter twig, enlarged.

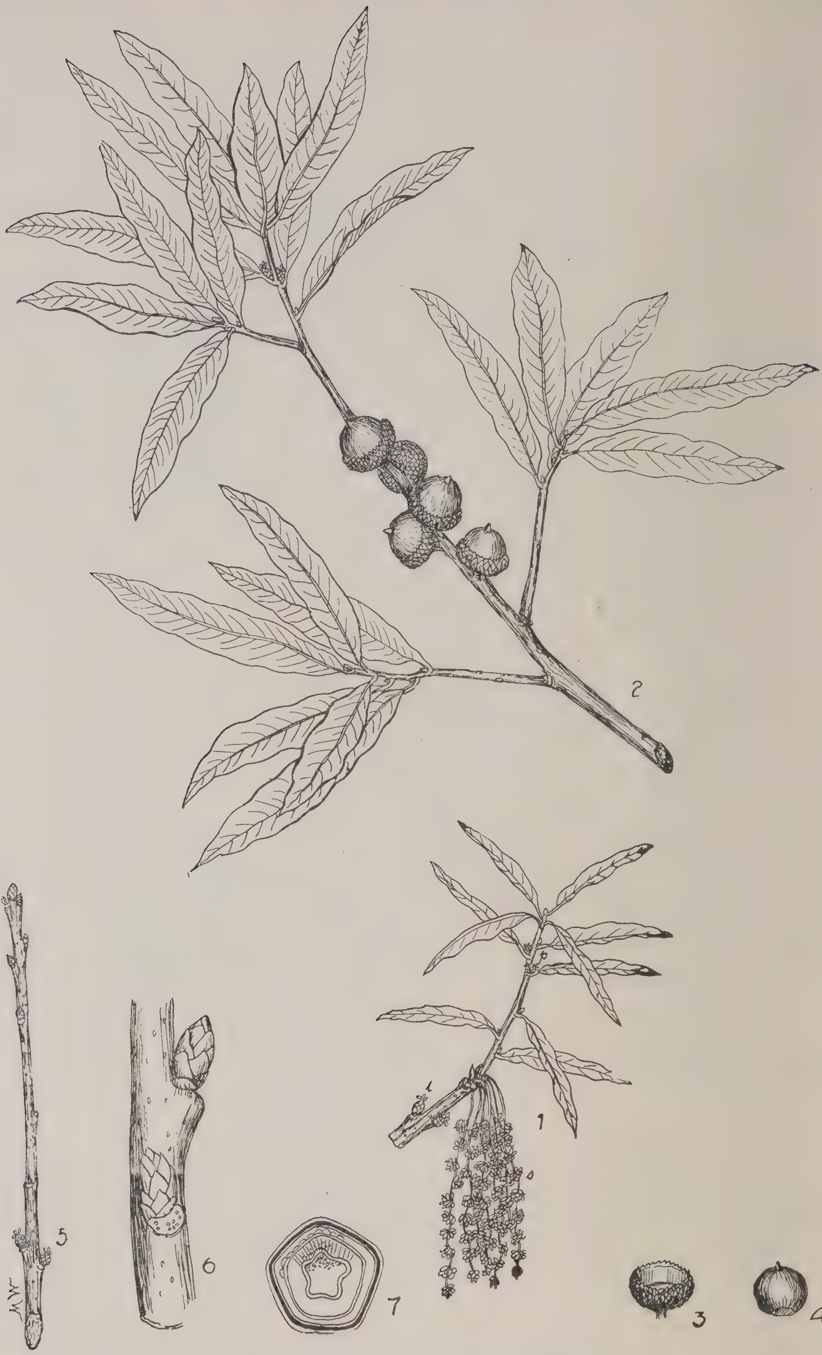

PLATE LXX. WILLOW OAK

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with buds, lenticels, and immature acorns, x ½.
6. Section of winter twig, enlarged.
7. Cross-section of twig showing pentangular pith, wood with conspicuous medullary rays, and bark, enlarged.

WILLOW OAK

Quercus phellos, Linnaeus

FORM—This tree usually attains a height of 50-60 ft. with a diameter of 1½-2 ft., but may reach a height of 80 ft. with a diameter of 4 feet. Crown usually narrow, rather open, pyramidal and round-topped.

BARK—Reddish-brown, ½-¾ of an inch thick, shallowly fissured and scaly.

TWIGS—Rather stout, smooth and shining during first winter, reddish-brown to dark brown.

BUDS—Alternate, ovate, about ⅛ of an inch long, strongly angled, sharp-pointed, covered by loosely overlapping dark brown scales which are slightly serrated on the margin.

LEAVES—Alternate, narrowly elliptic, sometimes lanceolate, narrowed at apex and base, 3-5 inches long, ½-1 inch wide, entire or with slightly wavy margins; terminated by a sharp bristle-pointed apex.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 138.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate flowers slender, hairy, yellowish, 2-3 inches long. Pistillate flowers borne on smooth slender stalks.

FRUIT—An acorn, maturing at the end of the second season, usually solitary, sessile or nearly so. Nut hemispheric, ½ inch in diameter, pale yellow-brown, sometimes striate. Cup saucer-shaped, covers only a small portion of the base of the nut and is covered with close, thin, hairy, reddish-brown scales. Kernel is very bitter and yellowish in color.

WOOD—Ring-porous; with conspicuous medullary rays; strong, coarse-grained, rather soft and light brown. Weighs 47 lbs. per cubic foot. Used for fuel and to a limited extent for general construction and felloes in wagon wheels.

DISTINGUISHING CHARACTERISTICS—The Willow Oak, also known as the Peach Oak, Water Oak, Swamp Oak, and Pin Oak, may readily be distinguished from all the other oaks of Pennsylvania except the Laurel Oak by its characteristic leaf, which resembles the leaf of a willow rather than the typical oak leaf. The Laurel Oak is the only other Oak which bears a leaf that shows any resemblance, but its leaf is long and broader, more obtuse-pointed, and hairy beneath. The cups of the acorns of this species are flatter and the acorns smaller than those of the Laurel Oak. The buds of this species are dark chestnut-brown in color, while those of the Laurel Oak are light brown and not angular.

RANGE—From New York to Florida, westward to Kentucky, Missouri, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found only in the southeastern part of the State. Reported from Bucks, Chester, Delaware, Lancaster, and Philadelphia counties.

HABITAT—Usually found on wet sandy soil, and occurs frequently along swamps and streams, but occasionally is found on higher areas where it may reach a fair size.

IMPORTANCE OF THE SPECIES—The Willow Oak is so limited in its natural distribution in this State and its owod is of so little commercial importance that it cannot be considered of forestal value. It should not be planted for forestry purposes but deserves to be planted ornamentally, especially in parks and along avenues. It hybridizes with several species of other Oaks, especially the Red Oak, and these hybrids are often very attractive ornamentally.

THE NETTLE FAMILY—URTICACEAE

This family contains a great number of representatives, the majority of which are tropical. It contains trees, shrubs, and many other small plant forms. The trees and shrubs alone comprise over 1,000 species and are found in the temperature and tropical regions of both hemispheres. They grow usually at relatively low altitudes frequenting wet and swampy as well as dry and arid habitats.

Several representatives of this family are important timber trees while others are of less commerical importance. Occasionally they may form pure stands but usually are mixed with other trees. This family also contains representatives which are attractive ornamentally and used for hedges.

The leaves are simple, alternate, and usually deciduous. The fruit matures in one season, in some species in spring shortly after the blossoms, while in others it matures in fall. The seeds may germinate the same season or lie dormant over winter and germinate the following spring. The fruit of some genera is edible. It varies greatly in form and structure. The subjoined key based primarily on fruit will aid in distinguishing the genera of this family native to Pennsylvana:

KEY TO THE GENERA

Page

1. Fruit a berry; pith chambered, ...Celtis 158
1. Fruit not a berry, pith not chambered, ...2

2. Fruit a dry samara, winged all around; flowers mostly polygamous; sap not milky, ... Ulmus 155
2. Fruit an achene, not dry, not winged; flowers unisexual; sap milky, ...3

3. Fruit elongated, edible; leaves dentate 3-nerved; branches unarmed; both staminate and pistillate flowers in separate spikes, ...Morus 130
3. Fruit round, not edible; leaves entire; branches armed; staminate flowers in racemes, pistillate in heads, ...Maclura 159

THE ELMS—ULMUS, (Tourn.) LINNAEUS

The members of this genus are usually trees, rarely shrubs. About 15 species are known of which number 6 are native to North America and 2 to the State of Pennsylvania.

The leaves are simple, alternate, two-ranked, straight-veined, and unequal-based. The flowers may appear before or after the leaves. The 2 Elms native to this State produce their flowers early in spring before the leaves. The fruit of the native Elms ripens in spring shortly after the flowers have matured. It consists of a flat seed surrounded by a thin papery wing.

The trees yield valuable wood and some of them also produce a tough inner bark which is used for food, in medicine, and manufactured into ropes and coarse cloth. The Elms are not only valuable commercially but also attractive ornamentally. The native American Elm and the introduced English Elm (Ulmnus campestris L.) are not only beautiful in summer when covered with a dense foliage but also in winter when the little twigs and branches, and the massive trunk and limbs stand out against the sky. The subjoined key will aid in distinguishing the two native species of Elm and the commonly introduced English Elm:—

SUMMER KEY TO THE ELMS

Page

1. Leaves smooth above or nearly so; fruit ovate or oval, ciliate on margin; flowers on slender, drooping stalks, ... **U. americana** 157

1. Leaves very rough above; fruit circular, not ciliate; flowers nearly sessile, ...2

2. Small to medium-sized native tree; inner bark mucilaginous; branchlets and pedicels downy; fruit densely brown-hairy over seed, ... **U. fulva** 156

2. Large introduced tree; inner bark not mucilaginous; branchlets and pedicels smooth; fruit smooth throughout, ... **U. campestris** 155

WINTER KEY TO THE SPECIES

1. Bud-scales densely brown-hairy; inner bark mucilaginous; twigs grayish and rough, ... **U. fulva** 156

1. Bud-scales not densely brown-hairy; inner bark not mucilaginous; twigs not grayish nor rough, ...2

2. Buds chestnut-brown; bud-scales with darker margin; bark ridged; twigs without corky ridges; form of the tree decidedly deliquescent, ... **U. americana** 157

2. Buds smoky-brown to almost black; bud-scales rather uniform in color; bark rather firm, often roughened into oblong blocks; form of tree intermediate with an excurrent tendency, ... **U. campestris** 155

SLIPPERY ELM

Ulmus fulva, Michaux

FORM—A small to a medium-sized tree usually attaining a height of 40-60 ft. with a diameter of 1-2½ ft., but may reach a maximum height of 80 ft. with a diameter of 2½ feet. Crown broad and flat-topped. Limbs stout and ascending.

BARK—Thick, rough, longitudinally fissured, dark brown, tinged with red within. Inner bark fragrant, mucilaginous and slippery, whence its common name. See Fig. 85.

TWIGS—Rather stout, difficult to break on account of flexible bark, at first hairy and greenish, later smoother and grayish-brown, roughened by raised lenticels and raised leaf-scars.

BUDS—Alternate; terminal bud absent; ovate, about ¼ of an inch long, dark chestnut-brown, covered with about 12 overlapping bud-scales coated with rusty brown hairs. Flower-buds stout and located along side of twig while leaf-buds are relatively slender and located towards end of twig.

LEAVES—Alternate, simple, 5-7 inches long, oval to obovate, thick, dark green, rough on both sides, rounded and oblique at base, acute at apex, doubly toothed on margin.

LEAF-SCARS—Alternate, oval, raised, lighter than twig, contain usually 3 rather small and inconspicuous bundle-scars.

FLOWERS—Appear before the leaves from lateral propagative buds. The smaller vegetative buds located near the end of the twigs open later. Flowers are perfect and clustered on short stalks.

FRUIT—A short-stalked samara ½-¾ of an inch broad, consisting of a flat seed surrounded by a wing and maturing in spring a few weekst after the flowers have matured. The fruit is hairy only over the seed.

WOOD—Ring-porous; with rather indistinct medullary rays; pores of the summer wood arranged in tangentially concentric bands; pores of spring wood form a broad band of 3 or more rows. Wood is heavy, hard, strong, dark brown to red, coarse-textured, easy to split, very durable in contact with the soil. Weighs 45 lbs. per cubic foot. Used for posts, railway ties, slack cooperage, agricultural implements.

DISTINGUISHING CHARACTERISTICS—The Slippery Elm, also known as the Red Elm and Moose Elm, can be distinguished from the other Elms of Pennsylvania by its fragrant and mucilaginous inner bark and its dark chestnut-brown buds covered with dusty brown pubescence. It is a smaller tree than either the American or the English Elm. The leaves are rough, while those of the American Elm are slightly rough or smooth. The bark is not so rough nor the buds so dark colored as those of the English Elm. Its lateral branches are rather straight while those of the American Elm are drooping.

RANGE—Valley of the St. Lawrence, south to Florida, and west to North Dakota and Texas.

DISTRIBUTION IN PENNSYLVANIA—Scattered locally throughout the State. Generally absent in the high mountainous region. Most common in the valleys. Does not form pure stands.

HABITAT—It is commonly found on low rich soil, along streams, and on hillsides. In the southern part of Pennsylvania common on limestone outcrops.

IMPORTANCE OF THE SPECIES—The Slippery Elm does not attain a large size nor grow in habitats where other more valuable species will not grow, consequently it cannot be recommended for extensive planting for forestry purposes. It may be recommended for limited planting in wet places, especially on the border of streams and on limestone outcrops.

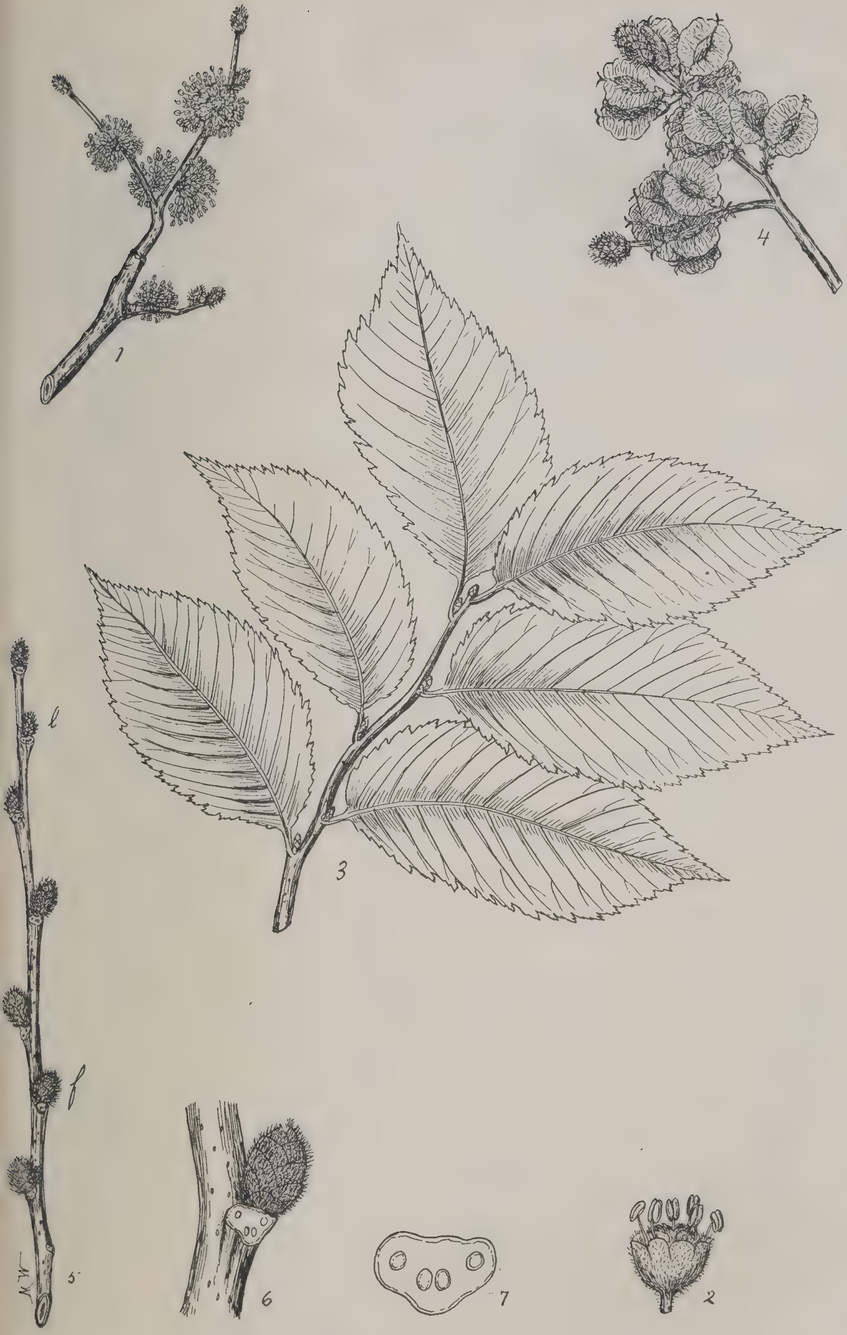

PLATE LXXI. SLIPPERY ELM

1. A flowering branch, x ½.
2. A flower, enlarged.
3. Branch with mature leaves, x ½.
4. Branch with mature fruit and expanding leaf-buds, x ½.
5. Winter twig with (f) flower buds, and (l) leaf-buds, x ½.
6. Section of a winter twig with a densely pubescent bud, enlarged.
7. A leaf-scar with bundle-scars, enlarged.

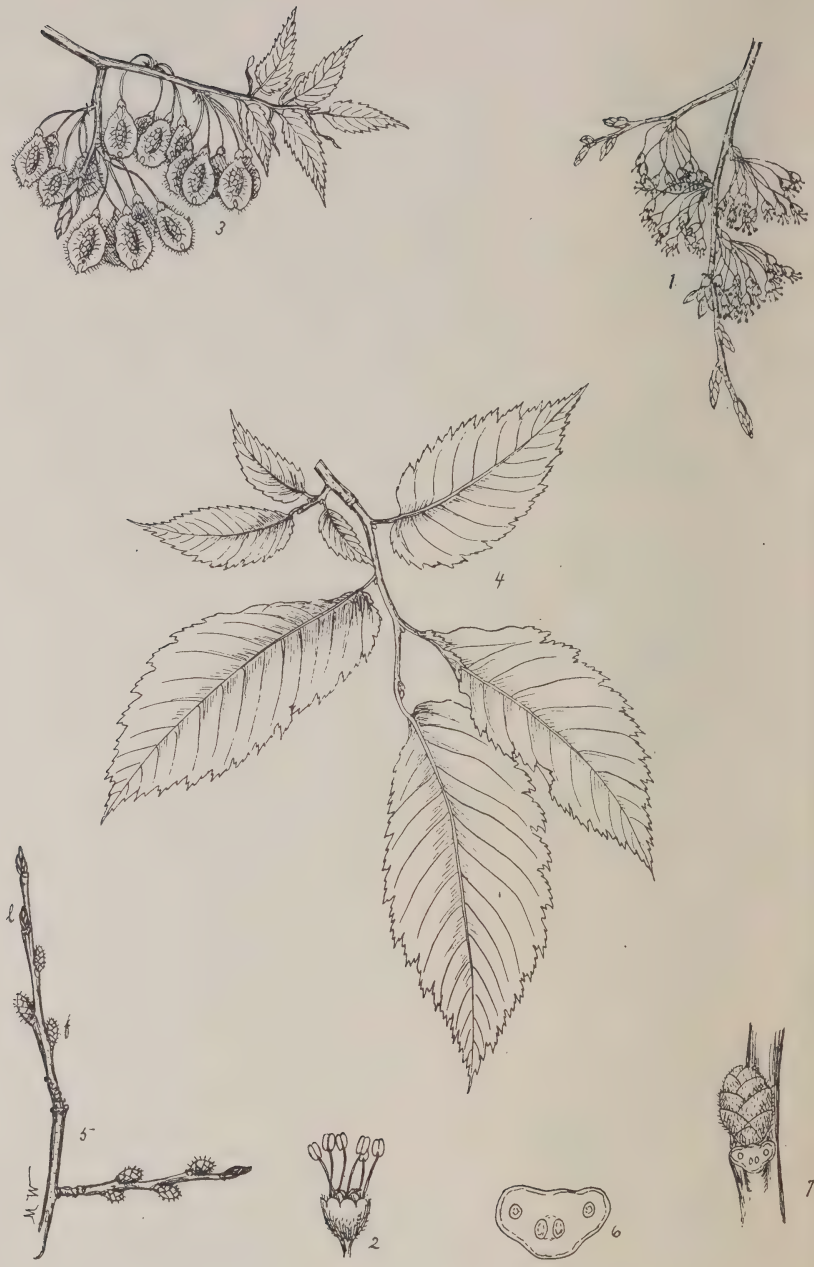

PLATE LXXII. AMERICAN ELM

1. Flowering branch with leaf buds, x ½.
2. A flower, enlarged.
3. Branch with mature fruit, immature leaves and an expanding bud, x ½.
4. Branch with mature leaves, x ½.
5. Winter twig with (f) flower buds, and (l) leaf buds, x ½.
6. A leaf-scar with bundle-scars, enlarged.
7. Section of a winter twig, with a slightly pubescent bud, enlarged.

AMERICAN ELM

Ulmus americana, Linnaeus

FORM—A large tree usually attaining a height of 80-100 ft. with a diameter of 2-4 ft., but may reach a height of 120 ft. with a diameter of 8-11 feet. A tree in Jefferson county, Pennsylvania, reached a height of 140 ft. and had a crown spread of 76 feet. It cut almost 9,000 board feet of lumber. The form is very valuable. The most common kinds which are recognized are "Vase Form," "Umbrella Form," "Oak Form," and "Feathered Form." Some trunks are tall and straight terminated by a shallow but broad crown composed of very gracefully drooping lateral branches. In open grown trees, the trunk often divides near the ground. The form may resemble the spray of a fountain. See Fig. 54.

BARK—Rather thick, grayish whence its name Gray Elm, roughened by long and irregular furrows separating rather broad, flat ridges which are usually firm but occasionally flaky or corky. Cross-section of bark often shows alternating white and brown layers.

TWIGS—Slender, at first greenish and pubescent, later smooth and reddish-brown, roughened by leaf-scars and pale, inconspicuous, scattered lenticels. Base of twigs marked with persistent ring-like bud-scale scars.

BUDS—Alternate; terminal bud absent; ovate, sharp-pointed, slightly flattened, reddish-brown, usually smooth, rarely slightly hairy, covered with about 6-10 overlapping reddish-brown scales with darker margin. Leaf-buds are smaller than the flower buds and located toward end of twig. Flower-buds are larger and located along side of twig. Buds are usually located above one end of leaf scar.

LEAVES—Alternate, simple, ovate, 4-6 inches long, thick, rough, unequally based, acute at apex, doubly-toothed on margin. Primary veins run straight from midrib to points of the teeth.

LEAF-SCARS—Alternate, 2-ranked, elevated, semi-circular, with corky surface, marked with three equidistant bundle-scars which may be compounded and are usually sunken.

FLOWERS—Appear before the leaves from lateral propagative buds. Flowers occur in 3-4-flowered clusters on drooping stalks about 1 inch long. They are perfect with greenish calyx, reddish anthers, and light green styles.

FRUIT—An oval samara, about ½ of an inch long, borne on a slender stalk; consists of a flat seed surrounded by a wing which is terminally deeply notched and ciliated on margin. Matures early in spring shortly after flowers.

WOOD—Somewhat similar to Slippery Elm, page 156, but differs slightly. Weighs 41 lbs. per cubic foot, is lighter in color than Slippery Elm, and has its pores in spring wood in a narrow band of usually less than 3 rows. Its wood has a wider range of usefulness.

DISTINGUISHING CHARACTERISTICS—The American Elm, also known as White Elm, Gray Elm, and Water Elm, can readily be recognized by its leaves which are smooth on the upper surface, and by the oval fruit with ciliate margin. The flowers occur on slender drooping stalks. The buds are only slightly pubescent and covered with chestnut-brown scales. The form and method of branching are very distinctive. Also see "Distinguishing Characteristics" under Slippery Elm.

RANGE—Few trees have so large a range. It extends from Newfoundland across Canada to the Rocky Mountains a distance of almost 3,000 miles and south to Florida and Texas, a distance of 1,200 miles.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State. Most common in the well-watered portions. Less frequent in the mountainous parts.

HABITAT—Prefers rich moist bottomlands. Is commonly found along streams, bordering lakes and ponds, and in rich alluvial soil. Usually mixed with other hardwoods.

IMPORTANCE OF THE SPECIES—The American Elm is the most valuable of all the Elms on account of its wide distribution, large size, valuable wood, and magnificent form. Michaux called it "the most magnificent vegetable of the temperate zone." it has not been planted much for forestry purposes but deserves to be planted, especially on rich soil which may be too wet for agriculture. It must be planted close in order to prevent the development of lateral branches.

HACKBERRY

Celtis occidentalis, Linnaeus

GENUS DESCRIPTION—The genus Celtis comprises about 60 species, of which number about 9 are native to North America and 1 to Pennsylvania. Representatives of this genus are found in temperate and tropical regions of both the eastern and western hemispheres. Another species known as Rough-leaved Hackberry (Celtis crassifolia, Lamarck) is also reported from 3 counties in this State. The leaves of the latter are very rough and the fruit is subglobose.

FORM—Usually a small tree 20-35 ft. in height, but single specimens with a height of 80 ft. and a diameter of 30 inches have been reported from this State. In the South it becomes larger. Trunk usually short. Crown rather wide-spreading and round-topped. Witches' brooms are frequently found upon it.

BARK—Grayish-brown, sometimes as smooth as Beech bark, others have very rough bark due to harsh, warty projections. Younger branches are dark brown to reddish-brown in color. See Fig. 121.

TWIGS—Slender, somewhat shiny, occasionally slightly downy, brownish, covered by scattered raised and often longitudinally-elongated lenticels; contain chambered white pith.

BUDS—Alternate, 2-ranked, small, often malformed and swollen, ¼ of an inch long, ovate, sharp-pointed, appressed, covered with 3-4 visible and closely overlapping bud-scales. Bud-scales sometimes longitudinally-striated and dark margined. Swollen buds caused by insects.

LEAVES—Alternate, simple, ovate, 2-4 inches long, acute at apex, obliquely rounded at base, serrate on margin, entire near base, rough on upper surface, with prominent primary veins. Petioles slender, slightly hairy and grooved.

LEAF-SCARS—Alternate, 2-ranked, small, semi-oval, at or almost at right angles to twig on projections of twig, with 1-3 bundle-scars.

FLOWERS—Appear about May. Three kinds, staminate, pistillate, and perfect, may be found. They are greenish and borne on slender drooping stalks.

FRUIT—A berry-like, dark purple, globular drupe about ¼-½ of an inch in diameter, tipped with persistent style and borne on a slender stalk. Matures about September and often persists into winter.

WOOD—Ring-porous; rays very distinct; pores in summer wood arranged in tangentially wavy bands; heavy, not strong, coarse-grained, yellowish. Weighs 46 lbs. per cubic foot. Used for fencing, crates, boxes, slack cooperage, hoe handles, agricultural implements. Resembles Ash. Most mills sell it as Ash.

DISTINGUISHING CHARACTERISTICS—The Hackberry, also known as Sugarberry, Nettle-tree, Hoop Ash, and Hack-tree, can be distinguished by its pith which is usually chambered, its berry-like fruit, warty or corky bark and disfigured twigs and buds. Abnormally swollen twigs are due to stings of gall insects. Witches' brooms are also common and very distinctive. The leaves resemble those of the Elms only are sharper pointed.

RANGE—Its range covers about 2,000,000 square miles in the United States, extending over the major part of the United States east of the Rocky Mountains.

DISTRIBUTION IN PENNSYLVANIA—Occasional throughout the State. Abundant along the Conococheague creek in the Cumberland Valley. Sometimes only a single tree is known in a locality. Large specimens are found in Northampton and Montgomery counties.

HABITAT—Prefers rich moist soil, but also grows on gravelly uplands. Does not form pure stands, but usually occurs solitary.

IMPORTANCE OF THE SPECIES—The Hackberry is of little commercial importance in this State since it is a rare tree and seldom reaches a large size. Only a few large trees have been recorded in this State. It cannot be recommended as a timber tree, neither has it any specially attractive ornamental qualities. Its continuity is insured because the birds carry the seed far and wide.

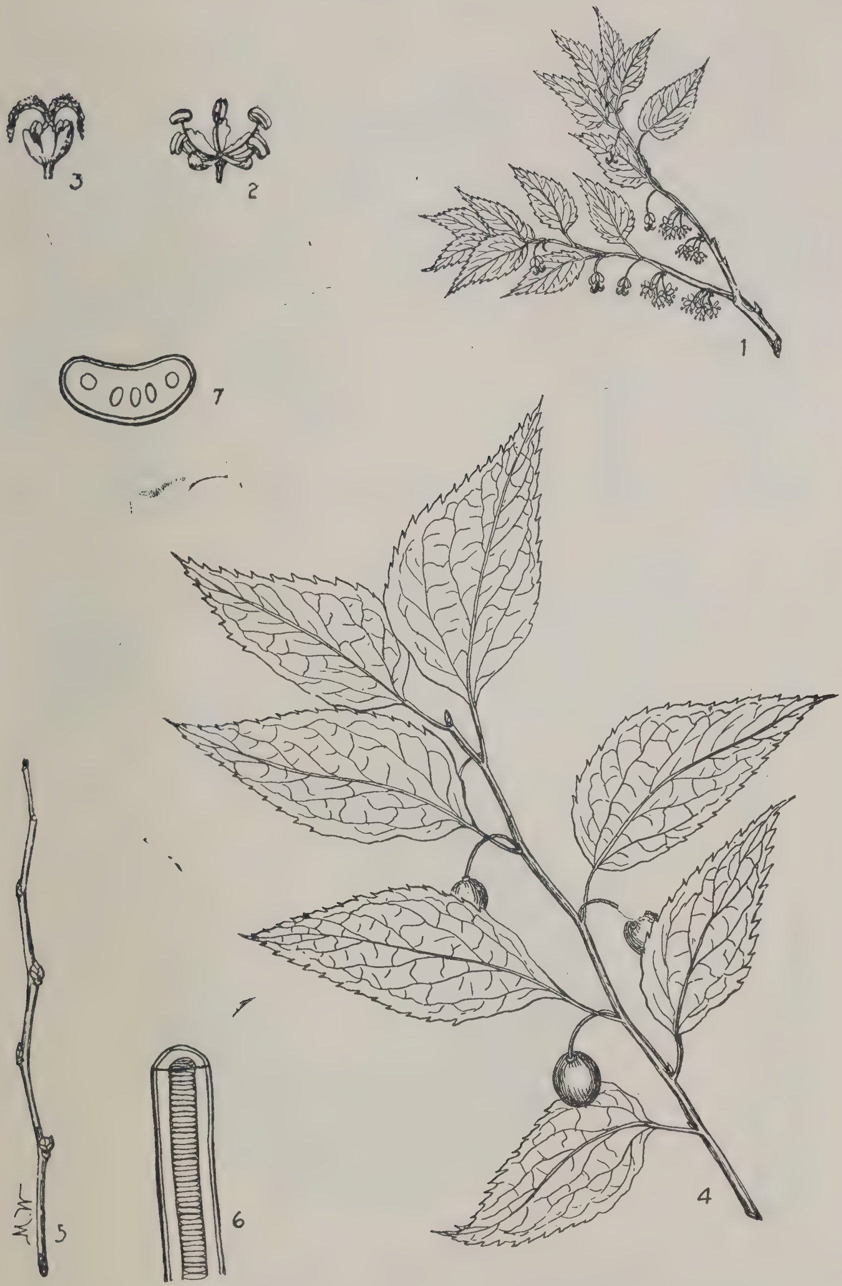

PLATE LXXIII. HACKBERRY

1. Branch with immature leaves, staminate and pistillate flowers, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. A branch with mature leaves and mature fruit, x ½.
5. A winter twig, x ½.
6. Section of a winter twig showing chambered pith; enlarged.
7. A leaf-scar with bundle-scars, enlarged.

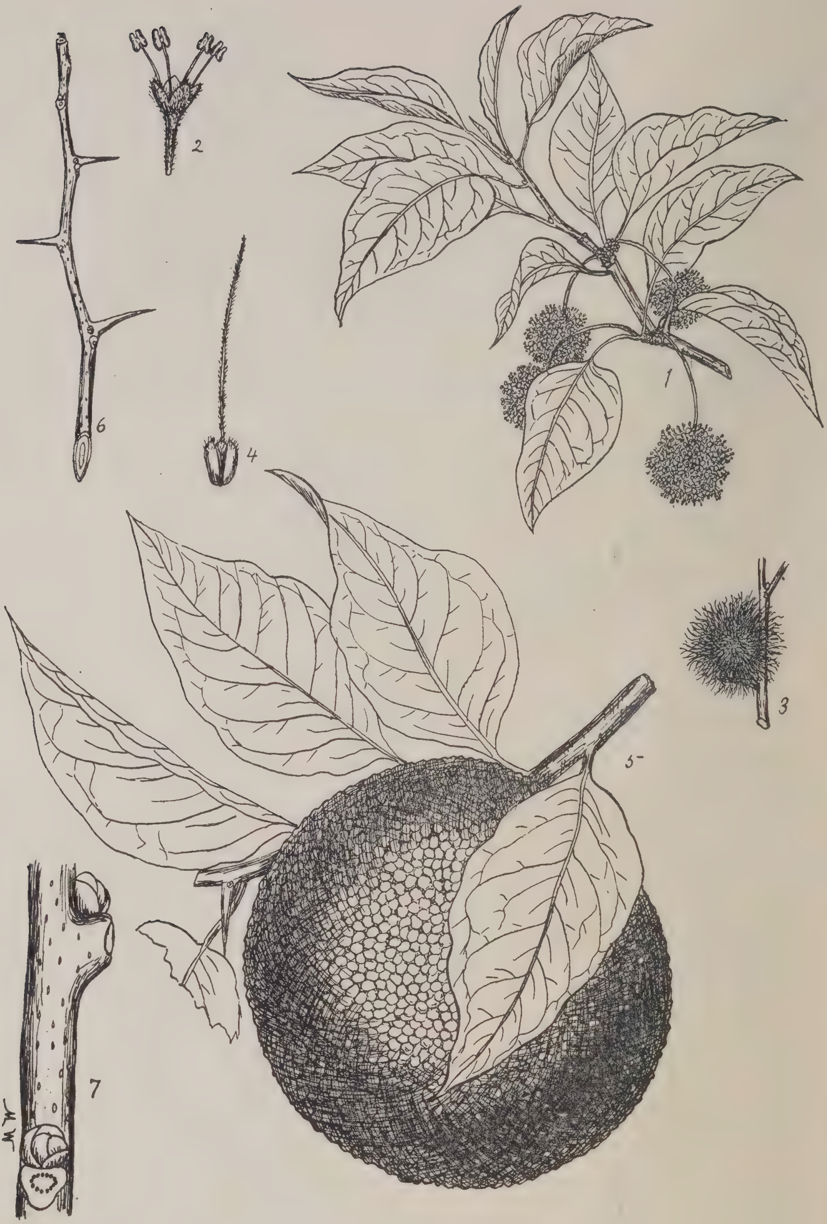

PLATE LXXIV. OSAGE ORANGE

1. Branch with immature leaves and heads of staminate flowers, x ½.
2. A staminate flower, enlarged.
3. Branch with a head of pistillate flowers, x ½.
4. A pistillate flower, enlarged.
5. Branch with mature leaves, and a single mature fruit, x ½.
6. A winter twig with three thorns, x ½.
7. Section of a winter twig showing lenticels, buds, and leaf-scars with bundle-scars, enlarged.

OSAGE ORANGE

Maclura pomifera, (Raf.) Schneider

GENUS DESCRIPTION—The species described on this page is the sole representative of the Genus Maclura.

FORM—A small or medium-sized tree usually attaining a height of 20-40 ft. naturalized region with a diameter of 12 inches but reaches a height of 50-60 ft. with a diameter of 2-3 feet. Trunk usually short, stout, often covered with dense growth of sprouts. Crown round-topped, rather open, often irregular. Branches in interior of crown often covered with stiff, spiny, and interlacing branchlets.

BARK—On older trunks rough, dark gray, about ¾-1 inch thick, longitudinally and sometimes diagonally furrowed, with prominent ridges which scale off into thin close-fitting scales. On branches it is thinner, pale brown tinged with yellow. Branches are often armed with straight axillary spines and contain yellow pith.

TWIGS—Alternate, rather stout, at first greenish and slightly pubescent, later yellowish-brown, contain yellow pith, marked by pale yellow lenticels. Younger branches are often armed with stout, straight, axillary spines and stout, spur-like, lateral branchlets.

BUDS—Alternate; terminal bud absent; equal-sized, broad, circular, with 5-7 small chestnut-brown scales.

LEAVES—Alternate, simple, about 4 inches long and 2½ inches wide, ovate in outline, wedge-shaped at base, acute at apex, entire on margin, dark green above, pale green below.

LEAF-SCARS—Alternate; located on twig enlargement at nodes; small to medium-sized, broadly triangular to elliptical, contain usually 1 or 3 bundle-scars, sometimes more.

FLOWERS—Appear about June when leaves are almost fully developed. Staminate flowers arranged in racemes on long slender drooping stalks; pistillate in dense heads with short stalks. Ovary is terminated by a long, slender, hairy style.

FRUIT—Pale green, orange-like in appearance, 4-5 inches in diameter, composed of many small drupes which are closely grown together. When punctured exudes a milky juice which turns black upon exposure.

WOOD—Ring-porous; rays rather inconspicuous; golden-yellow in color, streaked vertically with red stripes; heavy, very hard and strong, very durable. Weighs 48 lbs. per cubic foot. Used for fence posts, wagon felloes and rims, bridge piling, insulator pins, police clubs, rustic chairs, and tobacco pipes.

DISTINGUISHING CHARACTERISTICS—The Osage Orange, also known as Bowwood, Osage Apple-tree, Yellow-wood, and Hedge-tree, can be distinguished by its large orange-like green fruit. The twigs are armed with stout straight axillary spines, contain a milky juice and thick orange-colored pith and are covered with a light brown bark sometimes tinged with orange. The leaves are alternate, simple, and entire. Wood is very hard and orange to brown in color with light yellow sapwood. The roots are deep yellow in color and far-reaching.

RANGE—Oklahoma south to Dallas, Texas. Also reported from Arkansas. To date it has been planted in possibly every State in the Union.

~~DISTRIBUTION IN~~ PENNSYLVANIA—Introduced in practically every part of the State as a hedge or ornamental tree. In many localities in the State it has escaped cultivation.

HABITAT—~~It~~ is less exacting in soil than most of our trees, but when it has the privilege it chooses the best. In its natural range it thrives best on the black fertile flats, and rarely occurs on sandy soil. Occasionally found in swamps. Originally found in small pure stands.

IMPORTANCE OF THE SPECIES—The Osage Orange is not native to Pennsylvania but has been planted extensively for hedge and ornamental purposes. No wood is more valuable for fence posts. We have other trees which are more attractive as a hedge and the thorns which the tree bears are also objectionable when it is used as a hedge. It is difficult to eliminate it from an area where it has established itself.

RED MULBERRY

Morus rubra, Linnaeus

GENUS DESCRIPTION—The genus Morus comprises about 10 species of which number 3 are native to North America and 1 to Pennsylvania. Its representatives occur as trees or shrubs in eastern North America, Central America, South America and Europe but are most abundant in Asia. The White Mulberry (Morus alba L.) a native of Asia, has been planted extensively in this State, and in some localities has escaped cultivation.

FORM—Usually attains a height of 35-50 ft. with a diameter of 12-18 inches but may reach a height of 70 ft. with a diameter of 3 feet. Largest in Ohio and Mississippi valleys. Trunk usually short, subdividng near the ground. Crown usually broad, round-topped, and dense.

BARK—Begins to roughen about third year by splitting longitudinally or diagonally. On older trunks rather thin, dark grayish-brown, peels off in long narrow flakes which somewhat resemble the flakes of Catalpa. See Fig. 74.

TWIGS—Stout, smooth, glossy or occasionally dull, slightly zigzag, greenish-brown tinged with red, enlarged at nodes to bear buds and leaves, covered with few scattered inconspicuous lenticels, roughened at base of season's growth by ring-like bud-scale scars. A milky juice is excreted from twigs if they are cut or punctured.

BUDS—Alternate; terminal bud absent; ovate, round in cross-section, sharp-pointed, about 2/5 of an inch long, slightly divergent and laterally inclined, covered by 3-9 exposed bud-scales which are 2-ranked, greenish-brown to greenish-red with darker margin. Buds are located on twig enlargements. A bud is often found at end of twig; it is not a terminal bud but an axillary one sometimes called a pseudo-terminal bud which means false terminal bud.

LEAVES—Alternate, simple, ovate, 3-5 inches long, often cordate at base, serrate on margin, acute at apex, usually with 3 primary veins, except in lobed forms where more may be present. Usually not lobed but occasionally glove-form, 3-lobed or 5-lobed. Leaves are slightly rough on upper surface.

LEAF-SCARS—Alternate, 2-ranked, raised on twig enlargements, hollow or concave, almost circular, with raised bundle-scars arranged in an ellipse or distributed irregularly over leaf-scar.

FLOWERS—Appear May or June. Staminate flowers occur in narrow spikes about 2 inches long originating in axils of prospective or developing leaves or short hairy green stalks. Pistillate flowers occur in dense spikes about 1 inch long. Occasionally the staminate and pistillate are slightly mixed on a spike.

FRUIT—Appears about July. Compound or aggregate, about 1 inch long, composed of many small drupes, at first green, later red, finally dark purple, juicy, sweet and edible.

WOOD—Ring-porous; pores in summer wood small, in groups of 3-6 rays usually quite distinct; orange yellow to yellowish-brown, with thin nearly white sapwood; soft, not strong, durable in contact with soil. Weighs 37 lbs. per cubic foot. Used for fence posts, scythe snaths, cooperage, boat building.

DISTINGUISHING CHARACTERISTICS—The Red Mulberry, also known as simply Mulberry and sometimes Black Mulberry, can be distinguished by its large alternate 2-ranked greenish-brown buds with darker colored bud-scale margins, by its 3-veined leaves which have their veins sunken and are usually rongh on the upper surface. The milky juice of the twigs and its peculiar flowers and fruit are distinctive. The leaves are occasionally lobed. In winter the elevated and hollowed leaf-scars with bundle-scars arranged in an ellipse are characteristic. Its roots are bright yellow with a fibrous tendency.

RANGE—Massachusetts to Florida, west to Kansas and Nebraska.

DISTRIBUTION IN PENNSYLVANIA—Local and sparse in the eastern, southern, and south-western parts, occasional in the central part, and rare in the mountainous parts.

HABITAT—Prefers rich moist soil. Most common in valleys and on foothills. Usually mixed with other hardwoods.

IMPORTANCE OF THE SPECIES—The Red Mulberry does not produce wood of any special commercial importance because it is nowhere abundant and does not reach a large size. It is used for fence posts because it is durable in contact with the soil. The wood resembles Black Walnut when polished, only is somewhat lighter. It produces a pleasing effect when made up into furniture. It cannot be strongly recommended for forestry purposes but it is an excellent ornamental tree and also furnishes food for birds.

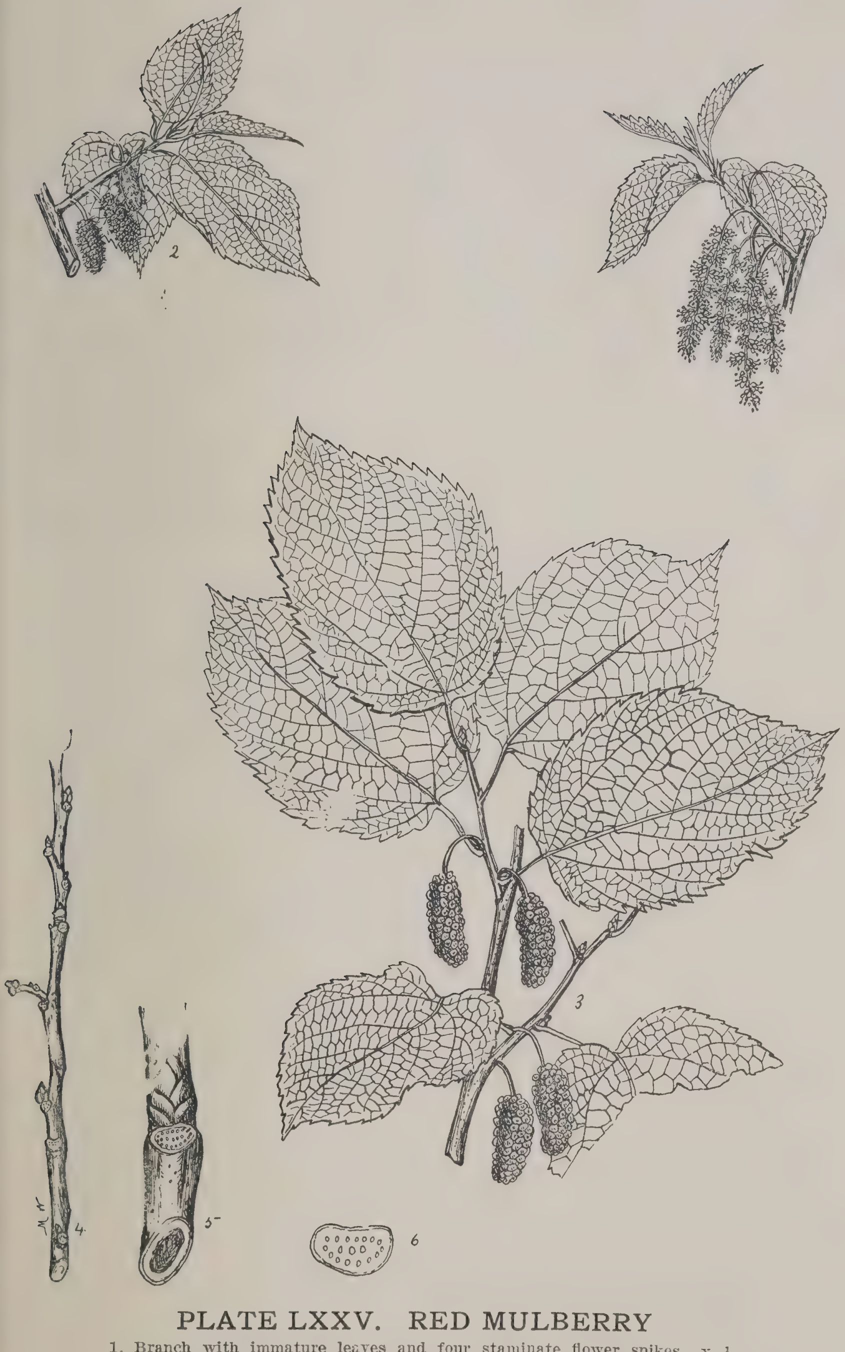

PLATE LXXV. RED MULBERRY

1. Branch with immature leaves and four staminate flower spikes, x $\frac{1}{2}$.
2. Branch with immature leaves and three pistillate flower spikes, x $\frac{1}{2}$.
3. Branch with mature leaves and mature fruit, x $\frac{1}{2}$.
4. A winter twig, x $\frac{1}{2}$.
5. Section of a winter twig, enlarged.
6. A leaf-scar with bundle-scars, enlarged.

THE MAGNOLIA FAMILY--MAGNOLIACEAE

The Magnolia family comprises about 10 genera with about 85 species of trees and shrubs, which are widely distributed in temperate and tropical regions. The flora of North America embraces 4 genera, 2 of which comprise only shrubs while the other 2 contain some of our well-known and important timber trees. The 2 arborescent genera, Magnolia and Liriodendron, include about 9 species in North America. Both genera are represented in the flora of Pennsylvania, the former with 3 and the later with 1 species.

KEY TO THE GENERA

Page

1. Leaves not lobed; fruit a cone of fleshy coherent follicles; buds ovate to conical, sharp-pointed, hairy at least within; leaf-scars lunate to oval usually with 3, sometimes many bundle-scars, ...**Magnolia** 161

1. Leaves 4-lobed or 6-lobed; fruit a spindle-shaped cone of dry carpels; buds flattened, oblong, blunt-pointed, smooth on both outside and inside; leaf-scars circular or sometimes slightly flattened at top with many scattered mundle-scars, ..**Liriodendron** 165

THE MAGNOLIAS—MAGNOLIA, Linnaeus.

The Magnolias are among the most beautiful trees native to the State of Pennsylvania. All the Magnolias have the appearance of tropical trees and in fact most of them do not venture far beyond warm latitudes. Their large, entire-margined, pinnately veined leaves and their large, solitary and conspicuous flowers are largely responsible for their tropical appearance. This genus derived its name from Pierre Magnol, a French botanist, who was sometime Professor of Botany in Montpellier and died in 1715. It embraces about 25 species of trees and shrubs, 3 of which are native to Pennsylvania. The members of this genus are natives of eastern North America, southern Mexico, the West Indies, and eastern and central Asia.

SUMMER KEY TO THE MAGNOLIAS

Page

1. Leaves crowded at the end of the flowering branches in an umbrella-like circle, and 12-24 inches long, ...**M. tripetala** 164

1. Leaves scattered along the branches, and 3-12 inches long, ...**2**

2. Large tree; leaves 4-12 inches long and deciduous; flowers green to yellow; follicles rounded, ...**M. acuminata** 163

2. Small tree or shrub; leaves 3-6 inches long, glaucous on under side, often persistent; flowers white; follicles tapering or tipped with styles, ...**M. virginiana** 162

WINTER KEY TO THE MAGNOLIAS

1. Buds 1-2 inches long and smooth on outside; leaf-scars large; twigs stout, ..**M, tripetala** 164

1. Buds less than 1 inch long, silky to almost smooth on outside; leaf-scars small; twigs slender, ...**2**

2. Large tree; leaves deciduous; twigs brown; bark furrowed and flaky; buds blunt-pointed, densely downy, ...**M. acuminata** 163

2. Small tree or shrub; leaves may persist; twigs green; bark smooth; buds green, pointed, hairy to smooth, ...**M. virginiana** 162

LAUREL MAGNOLIA

Magnolia virginiana, Linnaeus

FORM—Usually a small tree or shrub seldom exceeding a height of 25 ft. but in the south, particularly in Florida, may attain a height of 75 ft. with a diameter of 3 feet. In Pennsylvania rather small. Trunk usually short, often much swollen at the base.

BARK—On old trunks thin, gray, smooth to scaly; on young stems light gray to white and smooth.

TWIGS—Green, round, bitter, relatively slender, downy, later reddish-brown, roughened by broadly crescent-shaped leaf-scars. Pith has a tendency to become chambered.

BUDS—Alternate, bright green, 2/5-3/5 of an inch long, circular in cross section, pointed, decidedly hairy, covered by successive pairs of stipules. Each pair of stipular scales envelopes the leaf just above it.

LEAVES—Alternate, simple, oval to broadly lanceolate, 3-6 inches long, obtuse at apex, tapering at base, entire on margin, glaucous beneath. Fall off in autumn in the North but persist in the South. Persist until spring in Franklin county, Pennsylvania.

LEAF-SCARS—Alternate, scattered along twig, narrow, oval to crescent-shaped, with bundle-scars arranged in a broad U-shaped line.

FLOWERS—Appear latter part of June and in July in this State. Complete, solitary, globular, white, calyx and corolla of same color, about 2 inches long, and very fragrant.

FRUIT—Matures about October. Cone-like, fleshy to dry, scarlet, oval, about 2 inches long, composed of coherent follicles. Seeds are red, shiny, drupe-like and suspended at maturity by a thin long cord.

WOOD—Similar to that of the Cucumber Tree, page 163, except that its rays are higher and more crowded on the cross-section than those of the Cucumber Tree. Produces wood of commercial size only in the South. Weighs 31 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Laurel Magnolia, also known as Small Magnolia, or Sweet Bay, can be distinguished by its leaves which are 3-6 inches long, oval, obtuse, glaucous beneath, scattered along the branches, and often persist until spring. The leaves of both the other native species are larger. The flowers are globular and white while those of the Cucumber Tree are slender-bell-shaped and greenish tinged with yellow, and those of the Umbrella Tree are only slightly scented. The leaf-buds are silky while those of the Umbrella Tree are smooth or slightly hairy. Its small size will also aid in distinguishing it. The "Distribution in Pennsylvania" of the three native species will also aid in idetifying them.

RANGE—Eastern Massachusetts, south to Florida, extending west to Caledonia near Chambersburg, Pennsylvania, central North Carolina and through the Gulf States to Texas and southern Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Found only in the southeastern part of the State. Recorded from every county southeast of a line drawn through Northampton, Lehigh, Lebanon, Cumberland, and Franklin counties. Its western limit is at Caledonia near Chambersburg in Franklin county.

HABITAT—Prefers swamps and wet places. Found along creeks or in bottomlands adjoining creeks, lakes, or ponds. Often a low shrub under moisture-seeking trees like Red Maple, Yellow Birch, Black Gum, White Oak, Hemlock, White Pine, and Tulip Tree. Its associates often are Rhododendron and Mountain Laurel.

IMPORTANCE OF THE SPECIES—The Laurel Magnolia is of no commercial importance in Pennsylvania because of its small size, limited distribution, slow growth, and inferior wood. It is extremely attractive and may be classified among our most beautiful native shrubs. It is well adapted for ornamental planting, only it grows rather slowly.

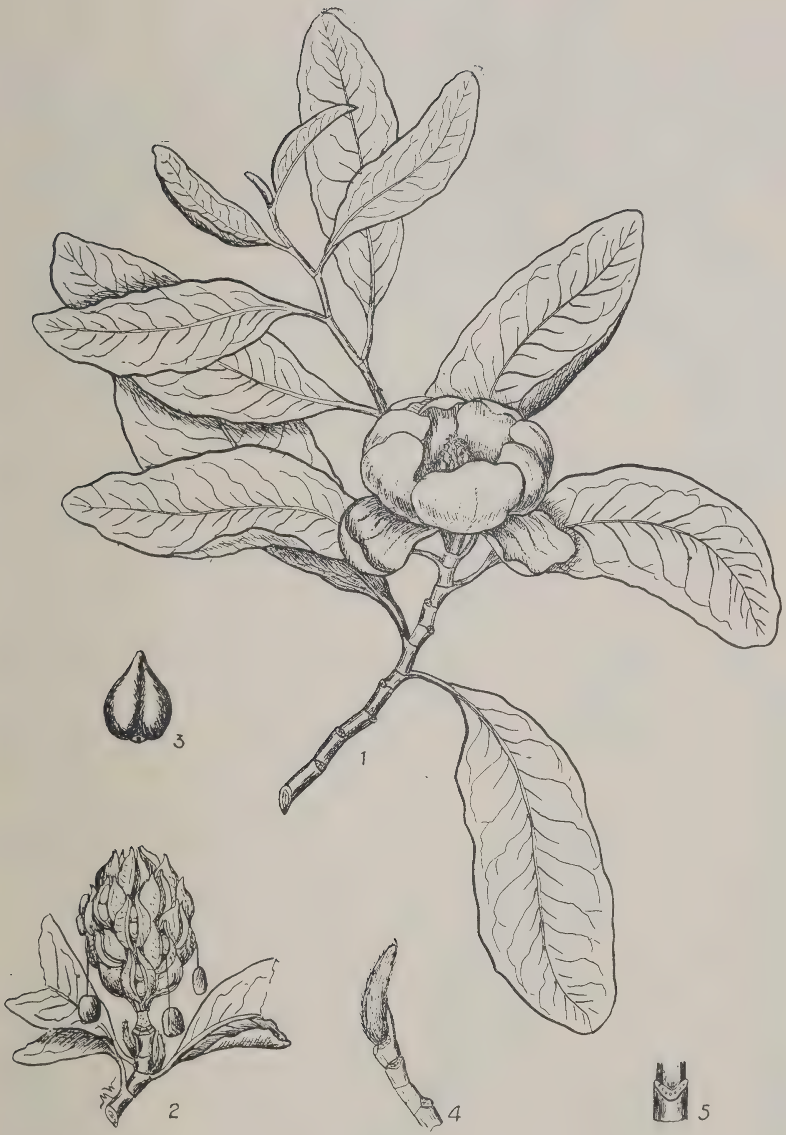

PLATE LXXVI. LAUREL MAGNOLIA

1. A flowering branch with mature and developing leaves, x ½.
2. A fruiting branch with portion of the leaves removed, x ½.
3. A seed, natural size.
4. A winter twig, x ½.
5. Section of a winter twig showing a leaf-scar with bundle-scars, natural size.

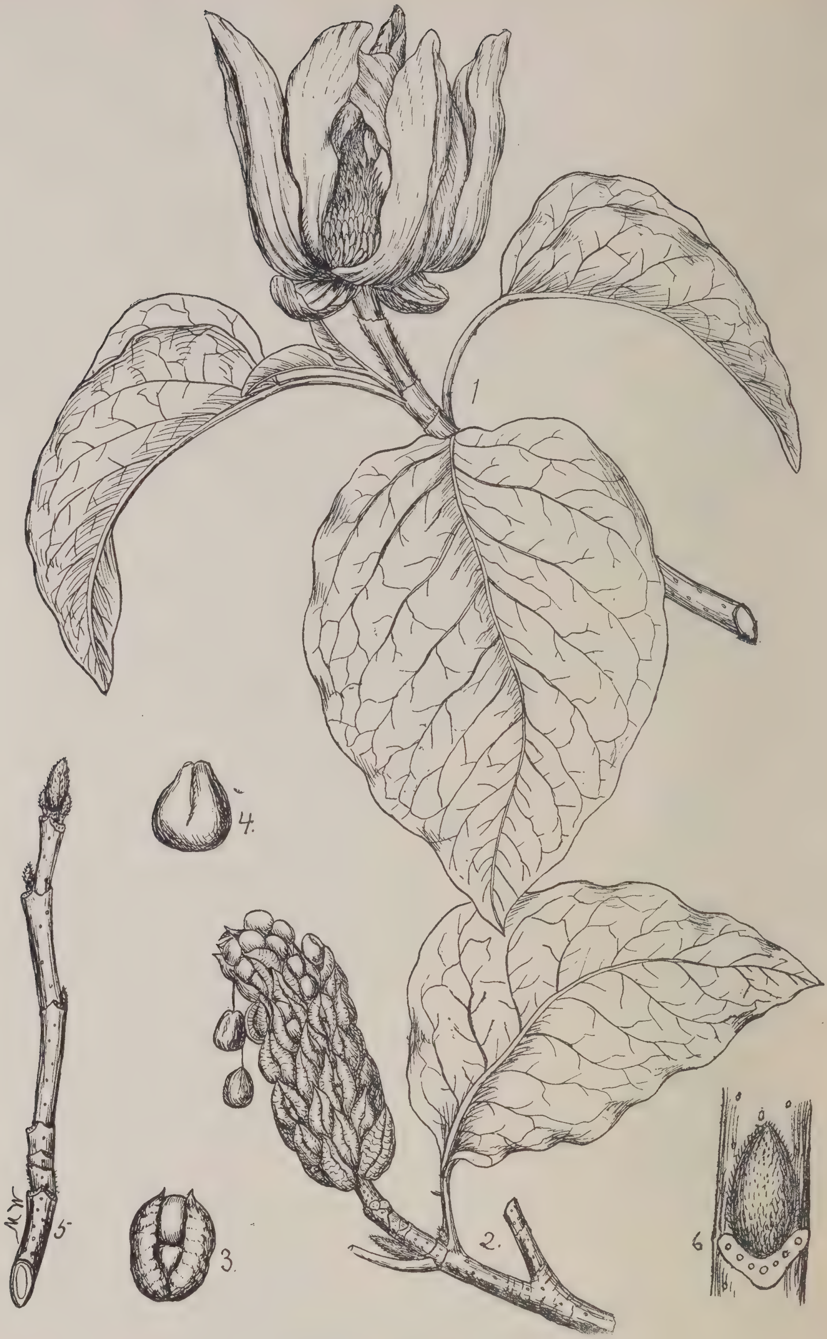

PLATE LXXVII. CUCUMBER TREE

1. A flowering branch with mature and developing leaves, x ½.
2. Branch with a cone-like fruit, seeds hanging by threads, and a mature leaf, x ½.
3. A carpel just starting to open, showing two seeds on the inside, natural size.
4. A seed, enlarged.
5. A winter twig, x ½.
6. Section of a winter twig showing a bud and a leaf-scar with bundle-scars, enlarged.

CUCUMBER TREE

Magnolia acuminata, Linnaeus

FORM—A large tree, which may attain a height of 90 ft. with a diameter of 3-4 feet. The form of the forest-grown tree is distinct from the open-grown. Open-grown specimens have a pyramidal crown with limbs originating all along the trunk from near the base to the narrow top. Lateral branches are wide-spreading and rather horizontal near the base, ascending and short at the top. Forest-grown specimens have straight, slightly tapering, rather smooth trunks which are free from branches often for 50 ft. from the ground. The largest log hauled out of the Hammersley Run of Potter county was a Cucumber. It was over 6½ feet in diameter at the small end.

BARK—Grayish-brown to brown, with long furrows separating long, rather loose, scaly ridges. See Fig. 104.

TWIGS—Usually slender, round, usually smooth but sometimes slightly hairy, shiny, bitter, covered with a few orange-colored inconspicuous lenticels, and contain white pith which may show a tendency to become chambered.

BUDS—Alternate, circular in cross-section, densely covered with thick, pale, silky hairs, terminal buds about 2/5-4/5 of an inch long and oblong; lateral buds ⅛-¼ of an inch long, blunt-pointed, nearly surrounded by leaf-scars. Buds are covered with valvate scales, the outer ones falling in spring, the inner ones developing into stipules.

LEAVES—Alternate, simple, ovate to oblong, thin, 4-12 inches long, pointed at apex, tapering or rounded at base, entire on margin, green and slightly downy beneath, with prominent midrib and primary veins on lower surface. Fall in response to first heavy frost in autumn.

LEAF-SCARS—Alternate, scattered along the twigs, narrow, crescent to broadly U-shaped, with its bundle-scars arranged in a U-shaped line. Bundle-scars number about 6-8.

FLOWERS—Appear from April to June. They are upright, solitary, complete, slender-bell-shaped, greenish tinged with yellow, about 3 inches long.

FRUIT—Matures about October. A red, cone-like or cucumber-like, cylindrical mass about 2-2½ inches long, composed of numerous coherent follicles. Seeds scarlet, drupe-like, and suspended at maturity by long, slender white threads.

WOOD—Diffuse-porous; rays distinct and rather uniform in width; light, soft, brittle, straight-grained, durable, does not warp when seasoning, light yellowish-brown to reddish-brown; sapwood is thin and yellowish-white. Weighs about 29 lbs. per cubic foot. Used for interior finish, furniture, pump stocks, as a substitute for Yellow Poplar, and for the same uses as White Pine. It is not so strong but more durable than the latter.

DISTINGUISHING CHARACTERISTICS—The Cucumber Tree can be distinguished by its leaves which are thin, oblong, pointed and green beneath. The leaves are larger than those of the Laurel Magnolia and smaller than those of the Umbrella Tree. The corolla is greenish tinged with yellow and the follicles of the cone-like fruit are rounded while the other two native species have white flowers and tapering follicles. It attains a much larger size and has sharper-pointed buds than the Laurel Magnolia and is considerably larger than the Umbrella Tree but has smaller and more downy buds. The bark is thicker and deeper ridged than either of the other species. The twigs are brown while those of the Laurel Magnolia are bright green.

RANGE—Western New York and southern Ontario south through West Virginia to Georgia; west to Illinois and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Found locally across the State from north to south in the mountainous regions and on their eastern and western slopes. Recorded as far east as Lancaster county. It, however, occurs only at isolated stations east of the Allegheny and North or Blue Mountains. The author found one small specimen in the South Mountains of Franklin county. Some large specimens have been reported from the western part of the State, where it occurs in Erie, Crawford, Lawrence, Mercer, Allegheny, Washington, and Greene counties.

HABITAT—Usually found in rich woods close to streams, also inhabits slopes In West Virginia and in this State it grows well on the soils of the carboniferous formation. It is light-demanding.

IMPORTANCE OF THE SPECIES—The Cucumber Tree is the most important of the Magnolias native to the United States. The wood is similar to that of Yellow Poplar. In addition to producing valuable wood it grows rapidly and is rather free from the attack of destructive agents. The value of the wood alone will justify reasonable efforts in attempting to propagate it. It is also attractive ornamentally on account of its large leaves and symmetrical crown.

UMBRELLA TREE

Magnolia tripetala, Linnaeus

FORM—A small tree sometimes attaining the height of 45 ft. with a diameter of 16 inches. Trunk short and slender, bearing a broad round-topped crown. Lateral branches stout and spreading, often turned up towards the end.

BARK—Smooth, thick, light gray, roughened by small irregularly scattered projections.

TWIGS—Stout, smooth, shining, at first greenish, later reddish to greenish-brown; bitter, swollen at the base of each year's growth, covered with a few conspicuous lenticels; contain large, white, pink-dotted pith.

BUDS—Alternate; covered with valvate scales in pairs; each successive pair encloses a leaf; terminal and lateral buds differ much; terminal up to 2 inches in length, narrow, conical, long-pointed, often curved towards the apex, smooth or glaucous, purple, with small dots; lateral small, often barely visible, conical, divergent.

LEAVES—Alternate, simple, obovate-lanceolate, 12-24 inches long, thin-pointed at apex, tapering at base, entire on margin; smooth when old; petioles 1-1¾ inches long.

LEAF-SCARS—Alternate, often clustered at swellings along the branch, large, conspicuous, oval, somewhat raised, contain numerous irregularly scattered bundle-scars. Stipulate-scars conspicuous, encircle twig, and originate from the side of the leaf-scar.

FLOWERS—Appear about May. Upright, solitary, complete, surrounded by a spray of leaves, white, slightly and unpleasantly odorous, 4-6 inches long. Sepals fall away early.

FRUIT—Matures about October. An oblong rose-colored, cone-like mass about 2-4 inches long composed of many coherent follicles which split open and liberate red flattish seeds. The fruit is very beautiful in autumn.

WOOD—In general resembles that of the Cucumber Tree, page 163. It is not used for commercial purposes because it is rare, small in size, light, weak, and brittle. Weighs 28 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Umbrella Tree, also known as Elkwood, is native only to a limited portion of the State in the Susquehanna River valley in the counties of York and Lancaster. It has larger leaf-scars, stouter twigs, larger fruit, larger and smoother buds, and larger leaves than the two other native species of Magnolia. Its leaves are crowded on the summit of the flowering branches in an umbrella-like cluster while those of the other two species are scattered along the branches. It is larger in size than the Laurel Magnolia but smaller than the Cucumber Tree.

RANGE—Southern Pennsylvania south to Georgia, west to Kentucky, Arkansas, and northern Mississippi.

DISTRIBUTION IN PENNSYLVANIA—Recorded only in the extreme southern part of the State in Lancaster and York counties along the Susquehanna River.

HABITAT—Usually found in swamps, along streams, or in ravines. It is tolerant of shade and usually occurs solitary; sometimes mixed with other hardwoods.

IMPORTANCE OF THE SPECIES—The Umbrella Tree is of no commercial importance in Pennsylvania on account of its limited distribution, its local and solitary occurrence, and the inferior wood which it produces. It is attractive and hence, may be recommended for lawn and park planting, but it cannot be recommended for forestry purposes.

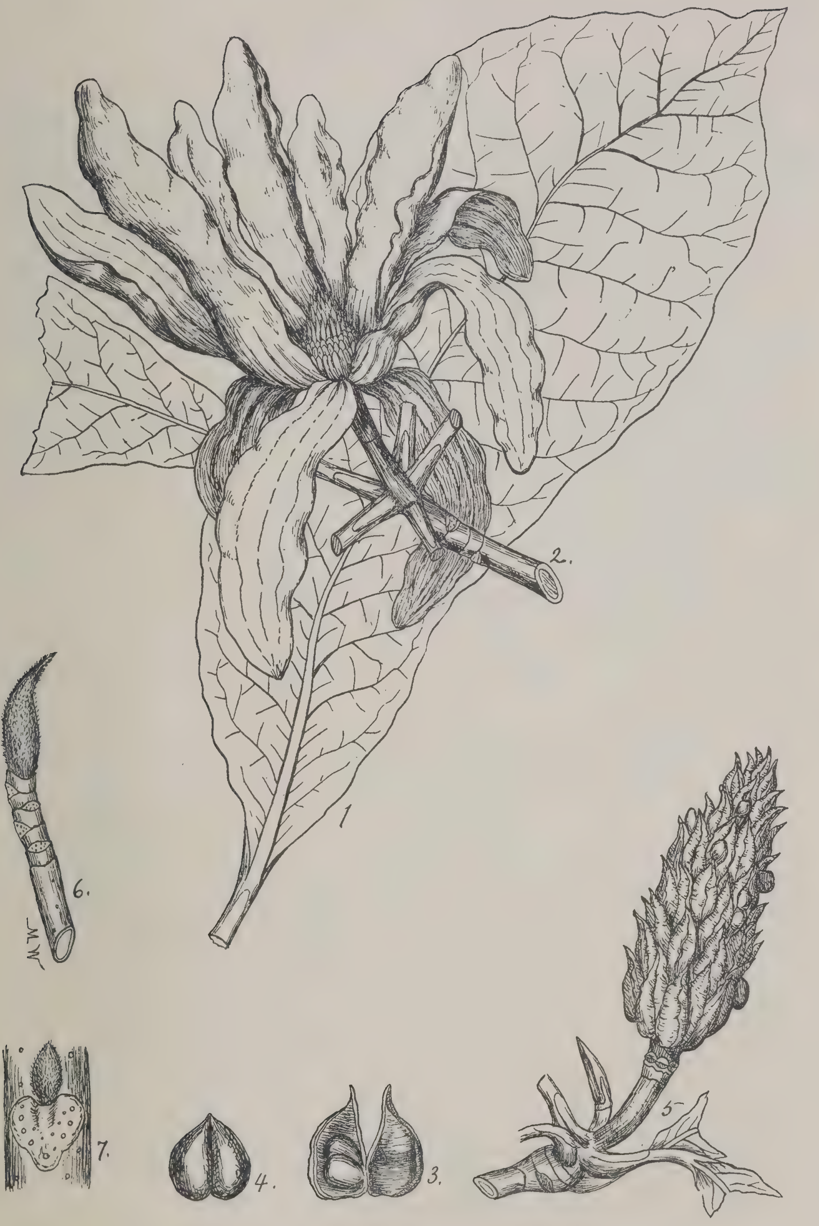

PLATE LXXVIII. UMBRELLA TREE

1. A mature leaf, x ½.
2. Branch with a single flower and the bases of five leaves arranged in an umbrella-like circle, x ⅓.
3. A carpel split open showing seeds, natural size.
4. A seed, enlarged.
5. Branch with a terminal cone-like fruit, x ½.
6. A winter twig, x ½.
7. Section of a winter twig, enlarged.

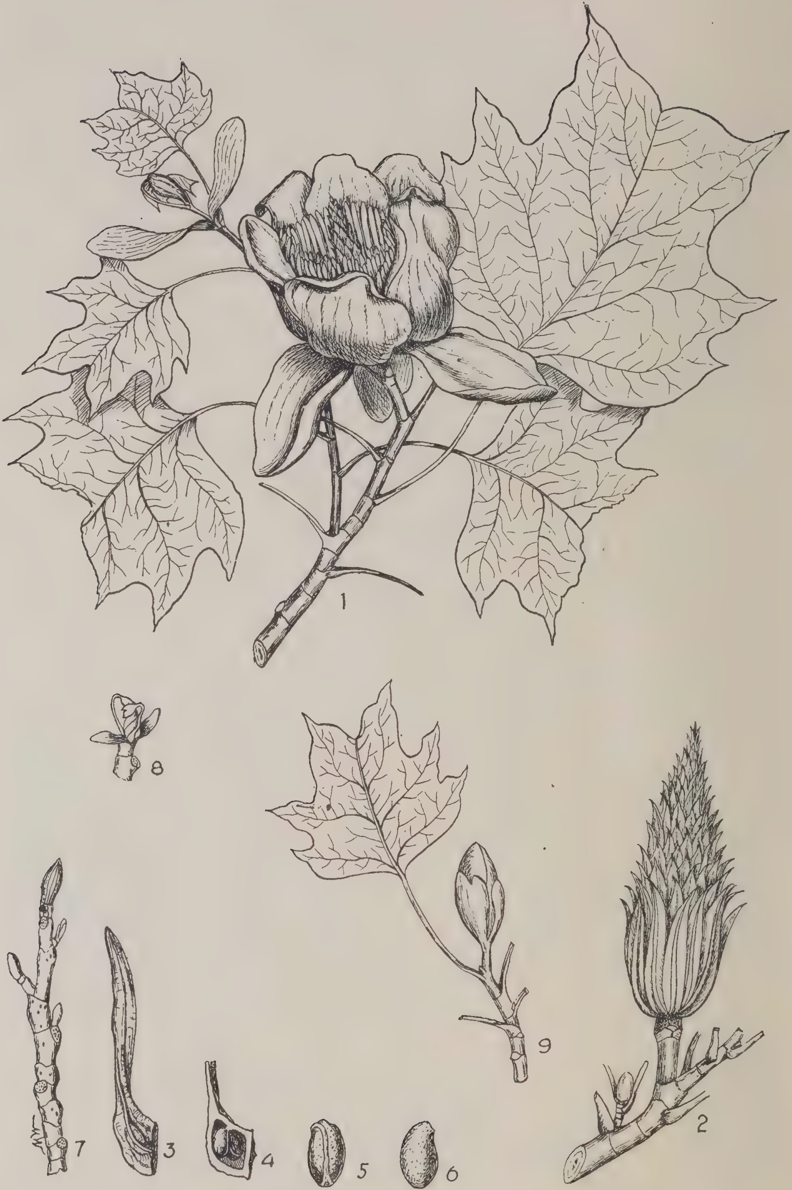

PLATE LXXIX. TULIP TREE

1. A flowering branch with mature and developing leaves, x ½.
2. Branch with a cone-like fruit, x ½.
3. A single carpel, natural size.
4. Portion of a carpel showing seeds, natural size.
5. A seed, enlarged.
6. Side view of a seed, enlarged.
7. A winter twig, x ½.
8. A terminal bud just opening, x ½.
9. A twig showing developing leaves, x ½.

TULIP TREE

Liriodendron Tulipifera, Linneaus

GENUS DESCRIPTION—This genus has numerous fossil representatives, but only one other living species, a native of China (Liriodendron chinesis, Sarg.) is known.

FORM—A large and interesting tree often attaining a height of 50-70 ft. with a diameter of 2-3 ft. and sometimes reaching a height of 200 ft. with a diameter of 10-11 feet. Prof. Guyot recorded a tree in Francis Cove, western North Carolina, known as the "Guyot or Granny Poplar," which had a diameter of 16 ft. and was free from lateral branches for more than 100 ft. from the base. Trunk tall, straight, very slightly tapering, free from lateral branches for a considerable distance from the base. Crown in young trees pyramidal, in older trees rather shallow, broad, and spreading. See Fig. 60.

BARK—When young smooth, bitter, ashy-gray. On trunks brown, thick, distinctly marked with long and regular furrows and ridges. At a distance it resembles the bark of the White Ash but lacks the characteristic diamond-shaped fissures of the latter. See Fig. 103.

TWIGS—During the first summer green, smooth, rather slender, often branching, marked with indistinct lenticels, encircled by a pair of stipules at each node. During first winter reddish-brown, smooth, shiny, marked by conspicuous pale lenticels, elevated leaf-scars and stipular rings encirculing the twigs, which often persist for many years.

BUDS—Alternate, large, smooth, flattened, oblong, blunt-pointed, reddish-brown mottled with white dots and covered with glaucous bloom. Lateral buds rather divergent, smaller than the terminal, sometimes superposed. Bud-scales smooth, white-dotted, spoon-shaped, velvate in pairs forming a distinct ridge where they meet. Each pair of stipular scales incloses in succession a reflexed, folded, stalked leaf with its 2 stipular scales. Stipular scales enlarge when the bud opens to a length of 2 inches and width of 1 inch. Each succeeding leaf is reflexed in the opposite direction of the preceding one.

LEAVES—Alternate, simple, broadly ovate in outline, truncate at apex, with 2 apical and 2-4 basal lobes, bright green above, paler below. Petioles slender, 5-6 inches long.

LEAF-SCARS—Alternate, elevated, conspicuous, large, orbicular. Bundle-scars small, numerous, scattered uniformly over the leaf-scar.

FLOWERS—Appear after the leaves; large, 1½-2 inches deep, cup-shaped, greenish-yellow, with 3 reflexed sepals and 6 converging petals.

FRUIT—Matures in September or October; a light brown, oblong, pointed cone 2½-3 inches long, ½ of an inch wide, consisting of carpels 1-1½ inches long in the base of which the seeds are contained.

WOOD—Diffuse-porous; with small inconspicuous medullary rays; soft, not strong, light, not durable in ground, easily worked, light yellowish or brownish heartwood with thin white sapwood. Weighs 26 lbs. per cubic foot. Used in construction, interior finish, furniture especially in veneering, shingles, wooden-ware and automobile bodies. Its uses are somewhat similar to White Pine.

DISTINGUISHING CHARACTERISTICS—The Tulip Tree, also known as Yellow Poplar, Whitewood, Tulip Poplar and sometimes Popple, can readily be recognized in summer by its straight clean fissured bole, its characteristic leaves with truncate apex and large stipules. The leaf cannot be confused with that of any other species since it appears from a distance to have its apex cut off at right angles to the midrib. In spring the flower is also distinctive. In winter the large clean trunks with their peculiar fissures in the bark together with the fruit which often persists, are characteristic. At close range the buds with the stipule-scars encircling the twigs will always enable one to recognize this species without fail. The rather large pith often divided by partitions of stone cells is peculiar.

RANGE—Botanical range from Rhode Island to Michigan and Missouri, south to Florida and Arkansas. Commercial range not so wide.

DISTRIBUTION IN PENNSYLVANIA—Commonest along streams or moist locations in the eastern, southern, and central parts of the State. Also found in western part, where it locally becomes abundant. Very rare in northern part of this State, where it may occur at lower elevations, if sheltered from frost, or at higher elevations in regions where the frost damage in the valleys is severe. It does not appear in pure stands, but some excellent stands almost approaching pure stands are found in Franklin, Adams, and Northampton counties.

HABITAT—It prefers deep, rather rich, and moist soil. Common along streams, on islands, upon semi-swampy areas, and at the base of mountain slopes. Sometimes found on the tops of mountains especially where small streams and springs are prevalent. Usually occurs as scattered individuals mixed with other hardwoods and sometimes White Pine and Hemlock. Does not occur upon the real limestone soil of the Cumberland Valley, but is common in moist situations along the adjoining mountain slopes and nearby ravines. This species, just as the Chestnut, does not seem to thrive on limestone soil.

IMPORTANCE OF THE SPECIES—The Tulip Tree is one of the most valuable and desirable timber trees of Pennsylvania. Its wood belongs in the first rank with White Pine. It is rather difficult to propagate artificially on account of the low fertility of the seeds and its sensitiveness to transplanting. Attempts have been made to propagate it by means of cuttings but without success. Natural seed regeneration of this species can be carried on with success and should be advocated and developed in preference to the artificial. This species is also free from insect and fungal diseases and most desirable as a shade, lawn, and avenue tree.

COMMON PAPAW

Asimina triloba, Dunal

FAMILY AND GENUS DESCRIPTION—The Custard Apple family, Anonaceae, comprises about 46 genera with 600 species confined mostly to the tropics. Only a few species are found in temperate regions. This family produces little that is of real economic importance. Only 2 genera, Asimina and Anona, are represented by tree species in the United States. The genus Asimina does not have representatives outside of North America, where about 8 species are known to occur. The sole representative of this family native to this State is the species described on this page.

FORM—A small tree usually 10-40 ft. in height with a diameter up to 12 inches. Trunk short and slender. Crown rather broad, high, and formed by straight rather spreading lateral branches.

BARK—Thin, close, sometimes slightly fissured, dark brown, often covered with scattered white blotches.

TWIGS—Round, olive-brown, enlarged at the nodes, rather slender, at first often somewhat hairy towards apex; later smooth, covered with a few fine lenticels which become evident during second year; pith small and white.

BUDS—Alternate, 2-ranked or sometimes 3-ranked, brown, naked, hairy. Terminal, lateral leaf and flower buds differ in size and form. Terminal bud is much longer than the others and evidently flattened. Lateral leaf-buds about ⅛ of an inch long, closely appressed to twig and located in notch on upper surface of leaf-scars. Flower-buds occur along the twig, spherical in outline, about 1/6 of an inch in diameter, very hairy and dark brown; do not stand quite parallel to twig.

LEAVES—Alternate, simple, obovate-lanceolate, 4-12 inches long, thin, pointed at apex, tapering at base, entire on margin, when mature dark green above and paler below. In autumn they turn rusty yellow.

LEAF-SCARS—Alternate, located on enlarged projections of the twig, inclined at about an angle of 35 degrees to the twig, broadly U-shaped, almost surround bud, somewhat lighter than the twig, contain usually 5 bundle-scars which are often compounded. A ridge extends across the leaf-scar from the bud to the base of the scar.

FLOWERS—Appear about April or May with the leaves but are usually located below them along the twigs. They occur solitary and axiliary; are perfect, at first green, later reddish-purple, 1-1½ inches wide, and borne on stout hairy stalks.

FRUIT—Suggests a stubby banana, is cylindrical, rounded, or occasionally blunt-pointed at the ends, 3-5 inches long, at first green, later dark-brown, pulp edible, contains many dark-brown, shiny, flattened seeds which are scattered throughout the flesh.

WOOD—Ring-porous with a diffuse-porous tendency; rays very numerous and distinct; heartwood brownish; sapwood yellowish; weak, soft, weighs about 25 lbs. per cubic foot. Not used commercially.

DISTINGUISHING CHARACTERISTICS—The Common Pawpaw can be recognized best in autumn by its unique fruit which is very suggestive of a stubby banana. In spring the greenish-brown to reddish-purple flowers which occur solitary along the twigs and measure 1-1½ inches across are also characteristic. The large, tropical-like, alternate leaves will also aid in recognizing it. In winter the long, slender, somewhat flattened, naked, brownish, terminal buds and the spherical flower-buds along the side of the twigs and the U-shaped leaf-scars which almost surround the buds and usually contain 5 bundle-scars, will enable one to distinguish it. The fact that is occurs only in about the southern third of the State may also help in distinguishing it.

RANGE—Western New York and west central New Jersey south to Florida and west to Michigan, Kansas, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Locally found in small groups in practically every county in the State south of a line drawn from Pittsburgh through Harrisburg and Reading to Doylestown in Bucks county. Reported as far north as Woodcock Valley, Crawford county, in the western part of the State. Not common anywhere but well known on account of its peculiar fruit. Usually found below altitude of 1,000 feet but in the South Mountains in Adams and Franklin counties found at 1,200 feet.

HABITAT—Prefers rich moist situations. Usually found in river valleys near streams but occasionally ascends low fertile slopes. It may form dense thickets but in this State usually occurs solitary or in rather open groups. Occurs with other species in the understory of the forest, and is very tolerant of shade.

IMPORTANCE OF THE SPECIES—The Papaw is of no commercial importance as a forest tree anywhere in its range. The fruit which it produces is of more value than its wood. It never reaches a large size, and in addition is local and limited in its distribution. It is, however, a very attractive tree on account of its somewhat drooping tropical leaves, handsome flowers, and peculiar fruit.

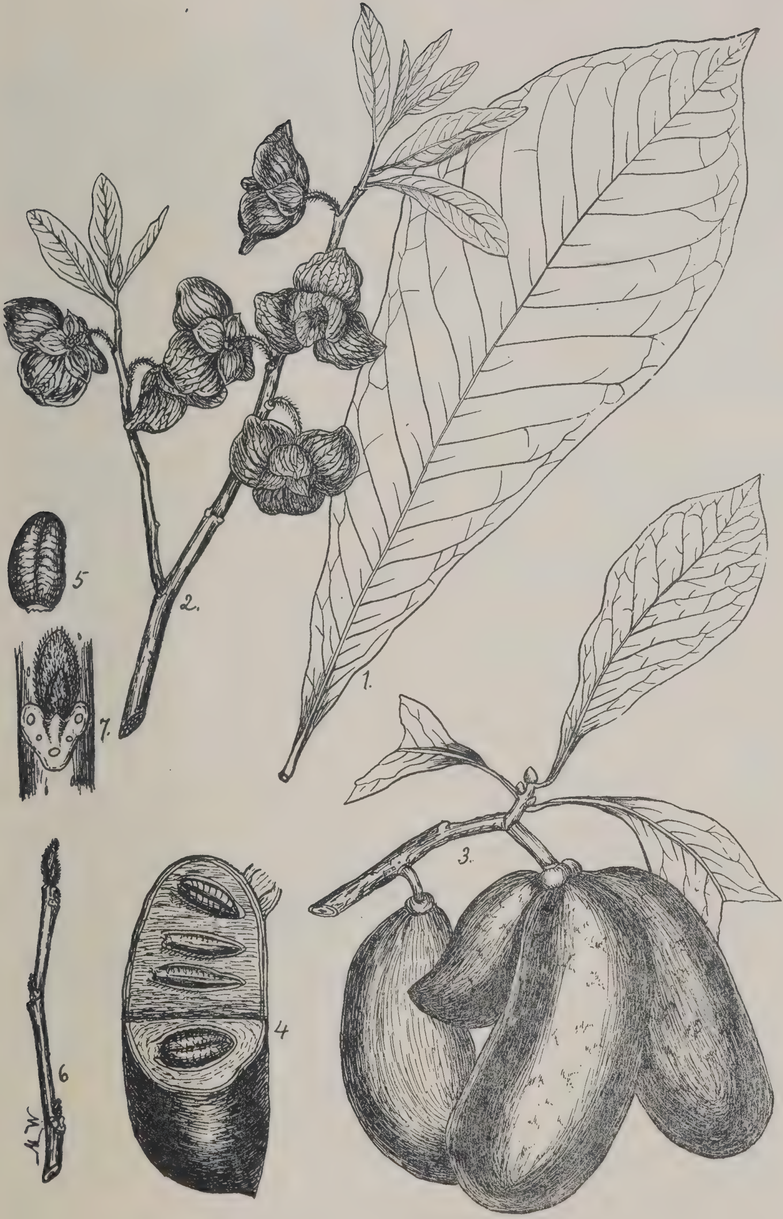

PLATE LXXX. COMMON PAPAW

1. A mature leaf, x ½.
2. A flowering branch with immature leaves, x ½.
3. A fruiting branch, x ½.
4. Section of a fruit showing seeds, x ½.
5. A seed, natural size.
6. A winter twig x ½.
7. Section of a winter twig, enlarged.

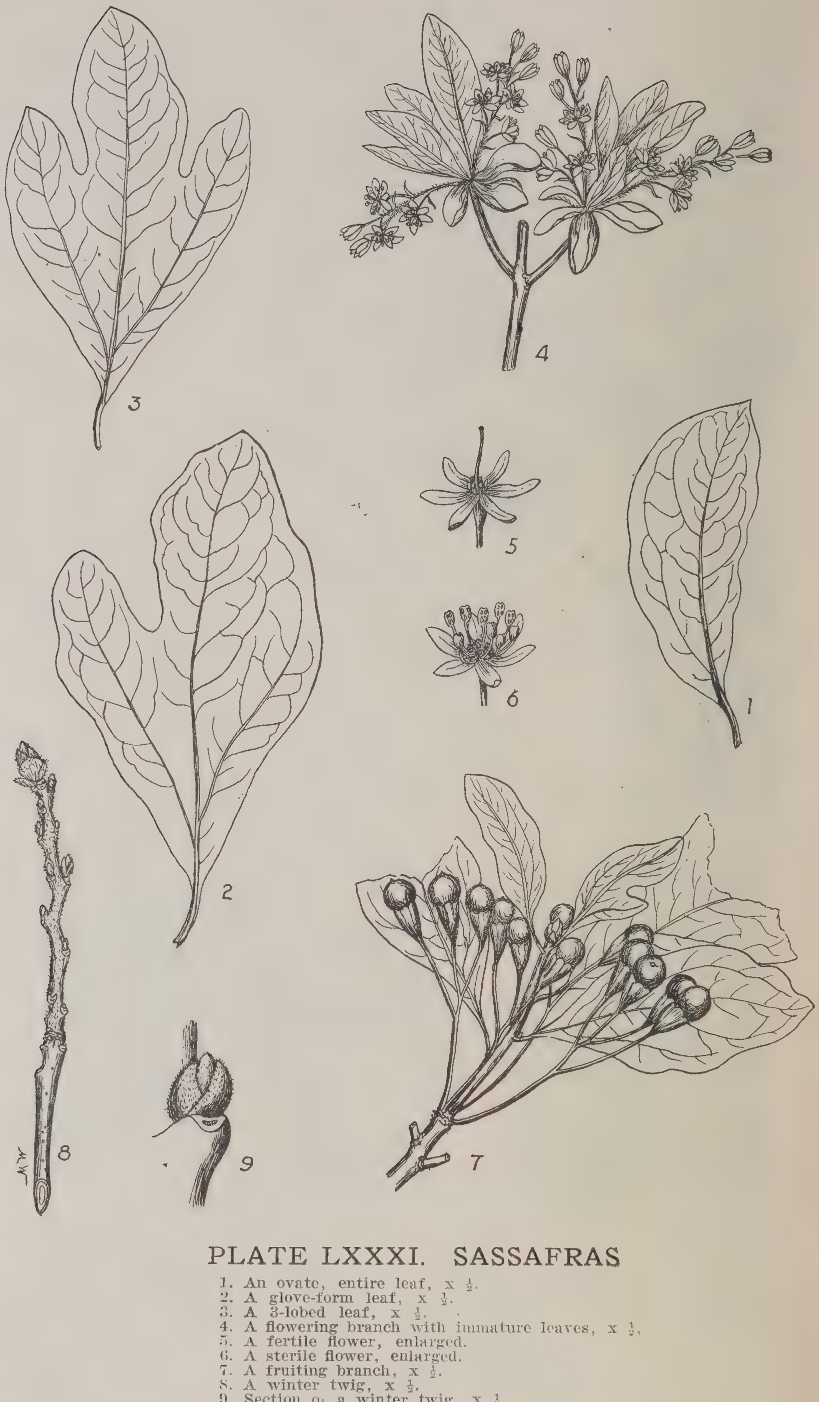

PLATE LXXXI. SASSAFRAS

1. An ovate, entire leaf, x ½.
2. A glove-form leaf, x ½.
3. A 3-lobed leaf, x ½.
4. A flowering branch with immature leaves, x ½.
5. A fertile flower, enlarged.
6. A sterile flower, enlarged.
7. A fruiting branch, x ½.
8. A winter twig, x ½.
9. Section of a winter twig, x ½.

SASSAFRAS

Sassafras variifolium, (Salisbury) Kuntze

FAMILY AND GENUS DESCRIPTION—The Laurel family, Lauraceae, comprises about 40 genera with between 900 and 1,000 species which are confined mostly to the tropics. Six genera are found in North America, 4 of which reach tree-size. Two genera, Sassafras and Benzoin, are native to Pennsylvania. The species described on this page is the sole representative in North America of the genus Sassafras, but another species is recorded from China. The sole representative in this State of the genus Benzoin is the Spice Bush (Benzoin aestivale (L.) Nees). The Spice Bush can readily be distinguished by its small size, its aromatic and spicy twigs,, its simple, entire, alternate leaves, its clusters of yellow flowers which appear before the leaves, and its scarlet fruit.

FORM—Usually reaches a height of 40-50 ft. with a diameter of 1-3 ft., but in the South may reach a height of 100 ft. with a diameter of 2-4 feet. Trunk usually stout, short, bearing a crown with more or less contorted branches. Crown usually flat-topped or rounded, the terminal part rather dense, the lower part very open. Branches are extremely brittle. See Fig. 59.

BARK—Roughened with shallow fissures frequently as early as the third year, hence a young tree often appears old. On older trunks reddish-brown, deeply fissured, and flat-ridged. Ridges resemble small blocks, or Ys, or Vs, and separate into thin appressed scales. Shallow, horizontal, and ring-like fissures sometimes almost encircle trunk. See Fig. 86.

TWIGS—Usually slender except in sprouts, rather brittle, yellowish-green or sometimes reddish, somewhat hairy, often smooth and glossy, aromatic, brittle, fall off young, covered with few lenticels, contain large white pith. Inner bark of twigs is very mucilaginous upon being chewed. Sprouts branch freely and seedlings more sparingly.

BUDS—Alternate, terminal but present, large, 1/3-3/5 of an inch long, ovate, sharp-pointed, covered with a few rather loose-fitting, slightly hairy green bud-scales with thickened veins. A few, usually 3, rather thick, loose, short, narrow scales surround terminal bud. Lateral buds are smaller, gaping, and somewhat divergent.

LEAVES—Alternate, simple, obovate, 4-6 inches long, acute at apex, wedge-shaped at base, entire or 2-5-lobed, usually smooth and dark green above and paler below. Entire, 2-lobed, 3-lobed, and 5-lobed ones may be found on same branch.

LEAF-SCARS—Alternate, small, raised, semi-elliptical or concave, with a single, confluent, linear bundle-scar.

FLOWERS—Appear about May with the leaves. Staminate and pistillate flowers are separate. They are greenish-yellow and arranged in loose drooping racemes.

FRUIT—A dark blue, shiny drupe borne on a bright red, club-shaped, fleshy stem terminated by an enlarged calyx in which the drupe rests. Falls rather early, rarely persistent.

WOOD—Ring-porous; with indistinct medullary rays; soft, very brittle, durable in contact with soil, aromatic, dull-orange brown, with thin light sapwood. Weighs 31 lbs. per cubic foot. Used for posts, rails, furniture, interior finishes. Often sold as Ash and Chestnut.

DISTINGUISHING CHARACTERISTICS—The Sassafras, also known as Saxifrax, and Sassifrac, can be distinguished at any time of the year by its very smooth glossy bark of the twigs which is decidedly mucilaginous and aromatic. The leaves which may be entire or 2-5 lobed and the single bundle-scar in each leaf-scar are also characteristic. The fruit, the rough and distinctively fissured bark, and the brittle lateral branches are peculiar to this species. Once recognized it is hard to confuse it with another species.

RANGE—Massachusetts to Florida and west to Michigan, Kansas, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Rather common in the eastern, southern, and western parts of the State. Rarer in the central and northern or mountainous parts. If found in the extreme northern part, it is usually met with on the plateaus and upper mountain slopes, above the line of severe frosts.

HABITAT—Very common along fence rows, in abandoned fields, and on abandoned charcoal hearths. Prefers rich sandy loam. Rather tolerant of shade and water.

IMPORTANCE OF THE SPECIES—The Sassafras is of little commercial importance in this State on account of its limited distribution and the small size which it reaches. It is a rather picturesque tree, especially in winter. The fruit furnishes a valuable food for birds while the wood, bark, and especially the roots, yield an aromatic oil extensively used to flavor medicine and candy, and to perfume soaps.

WITCH-HAZEL

Hamamelis virginiana, Linnaeus

FAMILY AND GENUS DESCRIPTION—The Witch-hazel family, Hamamelidaceae, contains about 16 genera with 50 species of which number only two genera have tree representatives in North America. The 2 genera are Hamamelis and Liquidambar. Each genus is represented by a single species, both native to Pennsylvania. The genus Hamamelis comprises 3 species, 2 of which are found in eastern Asia and 1 described here.

FORM—A small tree or shrub sometimes reaching a height of 25 ft. with a diameter of 14 inches, but usually smaller. Trunk short, bears numerous spreading, crooked branches which form a broad open head.

BARK—About 1/5 of an inch thick, light brown, somewhat mottled with light blotches; when young smooth, later scaly. Inner bark reddish-purple in color. Used for medicine, extract, and gargles.

TWIGS—Zigzag, light-brown, with small light green pith, rather slender, often downy or scurfy especially near the end, sometimes smooth and shiny, covered with a few, scattered, white lenticels.

BUDS—Alternate, 2-ranked, flattish, sometimes curved or falcate, covered with scale-like undeveloped leaves bearing dense brown hairs. Terminal buds usually sickle-shaped, about $\frac{1}{4}$-$\frac{1}{2}$ of an inch long. Lateral buds few and very small.

LEAVES—Alternate, simple, oval, 4-6 inches long, rounded or sometimes acute at apex, oblique at base, dentate on margin, dark green above, paler beneath; midrib and primary veins prominent.

LEAF-SCARS—Alternate, 2-ranked, semi-circular in outline with a raised margin, and contain 3 single or often compound bundle-scars which are lighter in color than the dark brown surface of the leaf-scar.

FLOWERS—Appear in October and November. Bright yellow, perfect, occur in small axillary clusters, surrounded by a scale-like 3-leaved involucre. Buds which produce the flowers occur in clusters of 3 on short stalks, are spherical in form, and start to develop about August in the axils of the leaves.

FRUIT—Ripens in October and November at the same time that the blossoms appear. It results from blossoms of the previous year, consists of a yellowish-brown woody pod with two cells in which shiny black seeds are produced. The woody pods burst open when ripe, and propel the seed for 5 or more feet.

WOOD—Diffuse-porous; rays not very distinct; little difference between spring and summer wood; hard, close-grained, light brown. Weighs 43 lbs. per cubic foot. Not used commercially.

DISTINGUISHING CHARACTERISTICS—The Witch-hazel can be distinguished in winter by its sickle-shaped, brown, terminal buds, its yellowish-brown fruit in the form of a woody pod with two cells, its persistent remnants of the flowers on stalks and its white blotched or mottled light brown bark. In late autumn the flowers with strap-like yellow petals are characteristic. The alternate oval leaves with straight veins and oblique bases are also distinctive. It usually frequents moist rocky locations. The Witch-hazel is the only tree in Pennsylvania that bears flowers and mature fruit at the same time.

RANGE—Nova Scotia and Ontario, south to Florida, and west to Minnesota and Texas.

DISTRIBUTION IN PENNSYLVANIA—No doubt found in every county of the State. Reported and observed in more than one-half of the counties, located in every part of the State. This is the most common and widely distributed small tree or shrub in Pennsylvania.

HABITAT—Usually found in moist rock situations. Common along streams, in swamps, and on the borders of ponds and lakes. Occasionally ascends slopes to rather dry locations. Tolerant of shade, hence often found in the understory of the forest.

IMPORTANCE OF THE SPECIES—The Witch-hazel is of no commercial importance because it remains too small and produces inferior wood. No records are available which show that a single board foot has ever been on the market. It is, however, a very interesting small tree because it holds a unique position in that it blossoms late in autumn when many other trees have shed their leaves and are prepared for winter. It may be protected in situations where it does not interfere with the growth or utilization of more valuable species. No special efforts are necessary to insure an abundant future supply.

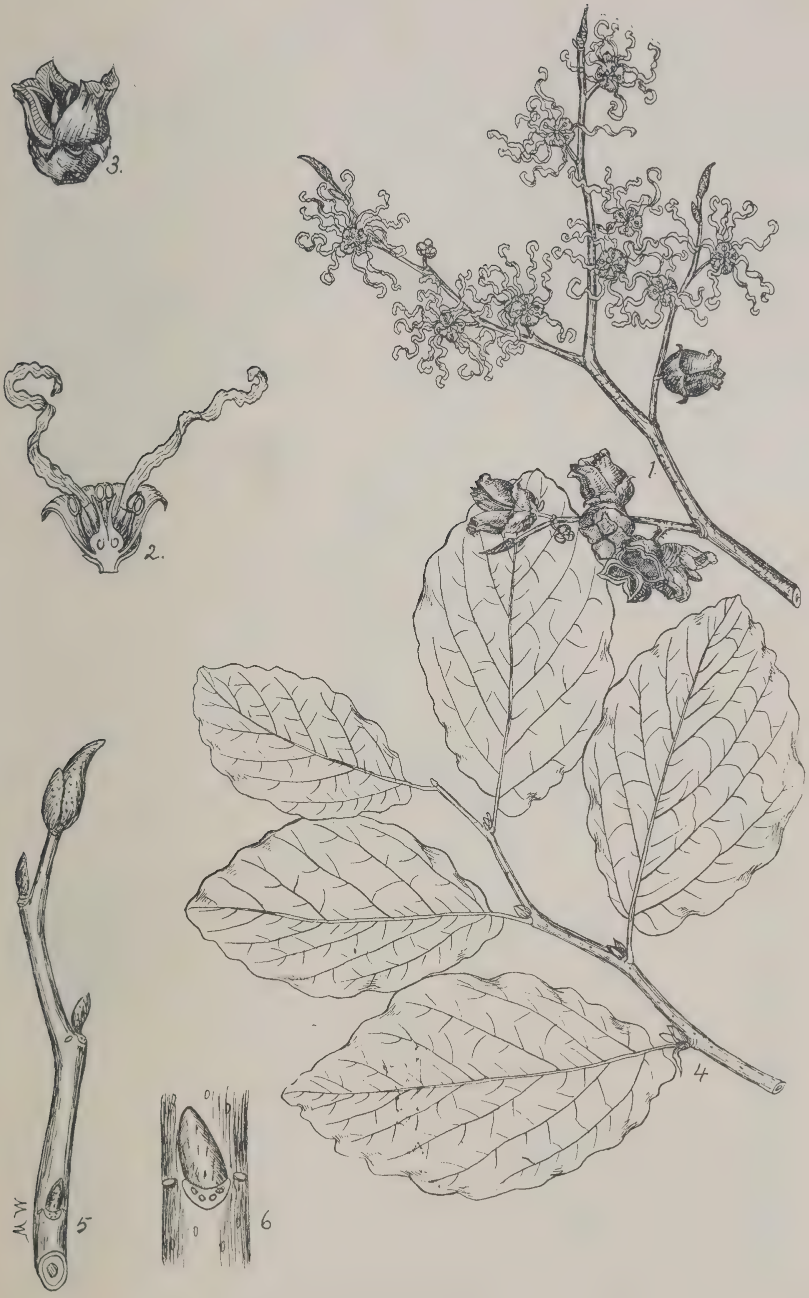

PLATE LXXXII. WITCH-HAZEL

1. A flowering and fruiting branch, x ½.
2. Longitudinal section of a flower, enlarged.
3. A fruit, natural size.
4. A branch with mature leaves, x ½.
5. A winter twig, natural size.
6. Section of a winter branch, enlarged.

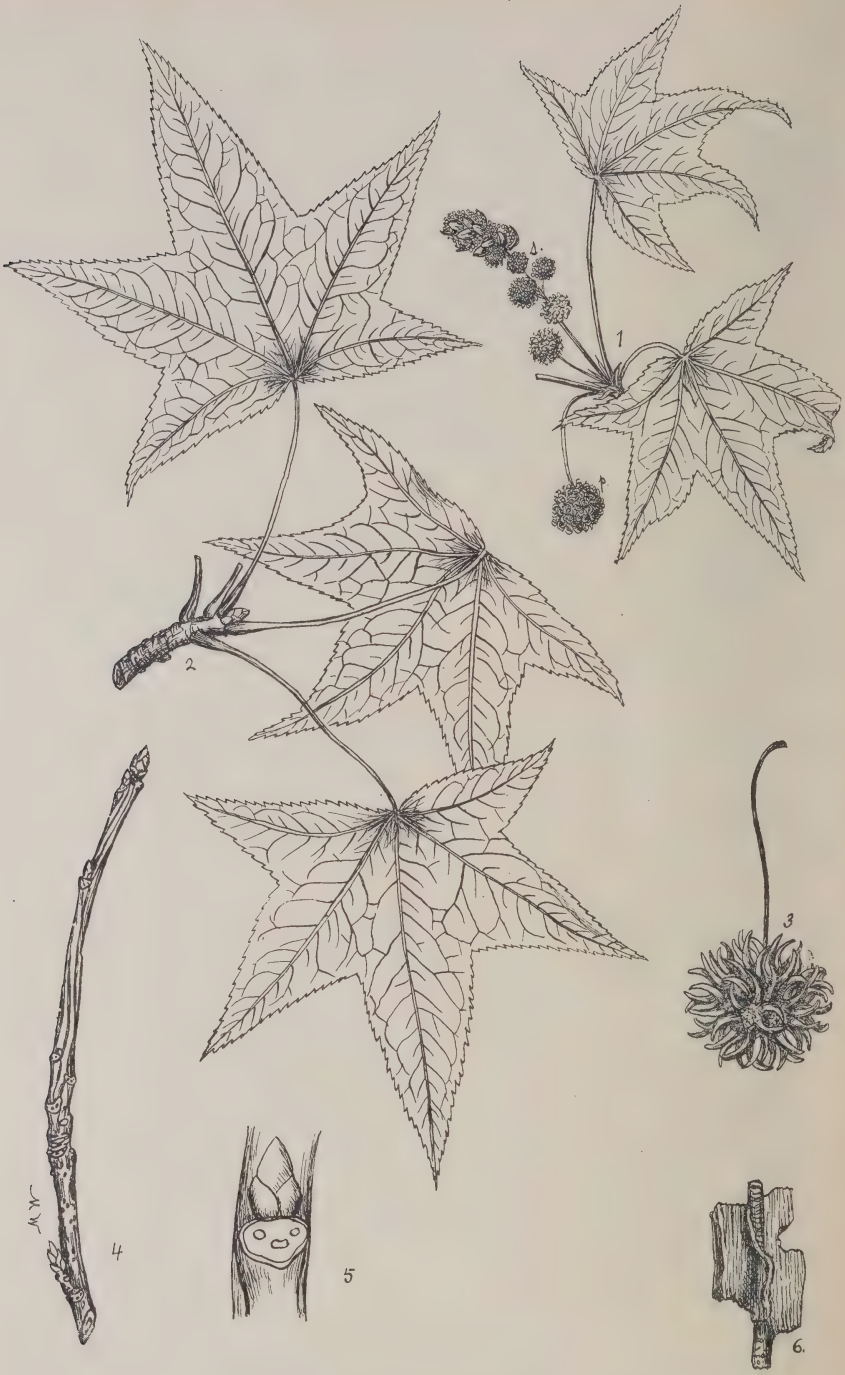

PLATE LXXXIII. SWEET GUM

1. A flowering branch showing immature leaves, (s) staminate flowers, (p) pistillate flowers, x ½.
2. A branch with mature leaves, x ½.
3. A spherical fruit, x ½.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.
6. Section of a branch with corky projections, x ½.

SWEET GUM

Liquidambar Styraciflua, Linnaeus

GENUS DESCRIPTION—This genus comprises 3 species, 2 of which are found in Asia and 1 in North America. The latter is native to a small portion of southeastern Pennsylvania. A few fossil forms are also known. The generic name, Liquidambar, is a mongrel, the fore part of which is of Latin origin and means liquid and the latter part of Arabic origin and means amber in allusion to the fragrant juice of the tree.

FORM—A large forest tree usually from 50-75 ft. high, with a diameter of 2-3 ft., but may reach a height of 150 ft. with a diameter of 4-5 feet. In the forest the trunk is tall, clean, slightly tapering, and bears a narrow head. In open grown trees the trunk is short, bearing rather regular spreading branches which form a symmetrical and rather conical crown.

BARK—On old trunks grayish-brown, 1-1½ inches thick, deeply furrowed separating broad scaly ridges. On younger trunks thinner and dark gray.

TWIGS—Rather stout, obscurely angular, at first rusty hairy, later smooth, light brown to dark-reddish-brown, roughened by raised leaf-scars and scattered, dark, raised lenticels and after the second season often by corky-winged projections of the bark. Pith rather large, angular, and very light brown.

BUDS—Alternate, more than 2 ranked, ovate to conical, blunt-pointed to sharp-pointed, glossy, rich reddish-brown, fragrant when crushed, covered with about 6 visible ovate scales which have a short-pointed apex, downy margin, and a rounded back. Lateral buds are sometimes accessory.

LEAVES—Alternate, simple, star-shaped, 3-5 inches long, broader than long; base at right angles to stalk or slightly heart-shaped; margin serrate, with 5-7 sharp-pointed divisions; when mature bright green and shiny above, paler below. Leaf-stalks long and round.

LEAF-SCARS—Alternate, more than 2-ranked, raised, slightly inclined to twig, crescent-shaped or broadly heart-shaped, with a dark surface, containing 3 circular bundle-scars which are white on the periphery and dark in the center.

FLOWERS—Appear about April when leaves are partly developed. Staminate flowers green, borne in terminal racemes, 2-3 inches long, covered with rusty hairs. Pistillate flowers green, occur in heads borne on long stalks originating in the axils of leaves.

FRUIT—A long-stalked spherical head made up of many capsules which have a spiny appearance, about 1-1½ inches in diameter, persists far into winter. Individual capsules often filled with sawdust-like material which consists of abortive seeds.

WOOD—Diffuse-porous; rays distinct; rather heavy, hard, with interlocked grain, somewhat difficult to work, reddish-brown with dark streaks, sapwood wide and white. Weighs 37 lbs. per cubic foot. Used for boxes, crates, furniture, interior finish, and extensively as a substitute for Circassian Walnut.

DISTINGUISHING CHARACTERISTICS—The Sweet Gum, also known as Bilsted, Red Gum, and Liquidambar, can be recognized by its fruit which is in the form of a spine-like head suspended on a long slender stalk. The fruit often persists far into winter. The corky-winged projections on the bark of the branches are also characteristic. The Bur Oak, a native species, and the Cork Elm, an introduced species, also have this characteristic. The star-shaped leaves, reddish-brown twigs, and leaf-scars with their bundle-scars are distinctive. It is native only to the extreme southeastern part of the State, but rather commonly planted in other parts.

RANGE—Southern Connecticut south to Florida and west to Ohio, Missouri, and Texas, and southward to Guatemala.

DISTRIBUTION IN PENNSYLVANIA—This is a Coastal Plain species, found only in the extreme southeastern part of the State. Reported from Bucks, Chester, Delaware, Montgomery and Philadelphia counties. It is common in Delaware county. Charles S. Mann, Hatboro, Pa., reports "a local group or belt of Sweet Gum of large size southwest of Hatboro, Montgomery county," and states that there are "beautiful groves of it near Hulmeville, Bucks county." It appears to be hardy in other parts of the State. Thrifty specimens are growing at Mont Alto, Harrisburg, Gettysburg, and Easton.

HABITAT—It prefers deep rich soil such as will produce White Oak, Hickory, and Yellow Poplar. Does not tolerate shade, hence almost invariably found in the open or in even-aged stands. On account of its intolerance one seldom finds it as regeneration on the forest floor.

IMPORTANCE OF THE SPECIES—The Sweet Gum attains a large size and produces fairly valuable wood but it usually requires soil adapted to agriculture or which will grow more valuable trees such as White Oak, White Ash, Hickory, and Yellow Poplar. It hardly pays to propagate this tree artificially in this State and it is too limited in its distribution to regenerate it by natural means. It is a very attractive ornamental tree.

THE ROSE FAMILY—ROSACEAE

This is one of the largest families of plants. It comprises about 100 genera with 1,500 species, many representatives of which are native to North America. The flora of Pennsylvania comprises about 30 genera with more than 100 species.

The members of this family comprise trees, shrubs, and herbs. They have a world-wide distribution. A few of the trees are important on account of the timber which they produce while many are important on account of the valuable fruit which they yield. Most of our common and well-known fruit trees belong to this family. Many of its shrubs are common and most attractive.

The leaves of the representatives of this family are simple or compound and always alternate, that is never opposite. The flowers are perfect, showy, and open in spring or early summer. Many species have very fragrant and attractive flowers. The fruit matures in one season and is variable in form and structure. It may take the form of achenes, follicles, pomes, or drupes. Some species like the Cherries, Plums, and Peaches have fruits which are edible and well known. Their pulp is usually juicy, sweet or bitter, sometimes astringent, and covers a hard-shelled, round or flat seed. On account of the palatable nature of most of the fruits they are readily eaten by man, birds, and wild animals. The seeds are not injured by passing through the alimentary canal of animals and hence may be thus widely dispersed. The wood in many species is valuable but in our flora all but one species remain too small to be of any commercial value.

Of the large number of genera and species found in Pennsylvania only 9 species belonging to 4 different genera are described below. In addition to these a few other genera have well-known representatives. The Ninebark (Physocarpus opulifolius, (L.) Maxim.), is a common shrub throughout the State along rocky banks of streams. It is the only representative of its genus in Pennsylvania. The Strawberries belonging to the genus Fragaria have a few common representatives. The Raspberries, Blackberries, and Dewberries, belonging to the genus Rubus, have about 20 species native to this State. The Wild Roses, belonging to the genus Rosa, have at least 7 species native to the State. In addition to these there are many herbaceous species.

KEY TO THE GENERA

Page

1\. Unbranched thorns present on twigs, situate at the nodes, ...Crategus 176

1\. Thorns not present on twigs, ...2

2\. Fruit a drupe; pistil one; twig with characteristic taste and odor, usually covered with horizontally-elongated lenticels, ...Prunus 171

2\. Fruit a pome; pistils more than one, usually 3-5; twigs with a different characteristic taste, without horizontally-elongated lenticels, ...3

3\. Cavities of the ovary same number as the styles; buds not narrow-conical and not greenish-yellow, ...Pyrus 178

3\. Cavities of the ovary becoming twice the number of the styles; buds narrow-conical and greenish-yellow, ...Amelanchier 180

THE PLUMS AND CHERRIES—PRUNUS, (Tourn.) Linnaeus

This genus comprises about 90 species well distributed over the north temperate zone and locally in the tropics. A large number of the representatives are found in North America. Seven species are native to Pennsylvania and 4 foreign species have been extensively naturalized. Only 4 of the native species are described on the following pages. The other native species are Porter's Plum (Prunus alleghaniensis), found near Birmingham, Huntingdon county, Appalachian Cherry (Prunus cuneata), and the Sand Cherry (Prunus pumila).

Among the introduced species which have been cultivated extensively are the Domestic or Sweet Cherry (Prunus avium), the Sour Cherry (Prunus Cerasus), the Perfumed Cherry (Prunus Mahaleb), and the Peach (Prunus Persica). The latter was introduced from Asia and the others from Europe.

SUMMER KEY TO THE SPECIES

Page

1. Flowers in racemes terminating leafy branches, hence appearing after the leaves, ...2
1. Flowers in umbels developing from lateral buds before or with the leaves, ...3

2. Leaves thickish, oblong or oblong-lanceolate, taper-pointed, serrate with short incurved stout teeth, inner bark aromatic, ...**P. serotina** 172
2. Leaves rather thin, oval to obovate, short-pointed, very sharply serrate with somewhat spreading slender teeth; inner bark with a rank disagreeable odor, **P. virginiana** 173

3. Flowers small; fruit small, borne in clusters; branches not thorny or armed, ...**P. pennsylvanica** 174
3. Flowers large; fruit large borne singly; branches often thorny or armed, **P. americana** 175

WINTER KEY TO THE SPECIES

1. Terminal buds absent, ...**P. americana** 175
1. Terminal buds present, ... 2

2. Buds clustered at the tips of the twigs; twigs rather slender usually less than 1/16 of an inch in thickness, ...**P. pennsylvanica** 174
2. Buds rarely clustered and if clustered only on stubby lateral spurs; twigs relatively stout, usually over 1/16 of an inch in thickness, ...3

3. Medium to large tree; bark on old trunks black and rough; buds relatively small with uniformily-colored scales sharp-pointed at apex, ...**P. serotina** 172
3. Small tree to shrub; bark on old trunks brown and rather smooth; buds relatively large with grayish-margined scales rounded at the apex, ...**P. virginiana** 173

WILD BLACK CHERRY

Prunus serotina, Ehrhart

FORM—Usually reaches a height of 50-75 ft. with a diameter of 2-3 ft., but may attain a height of 110 ft. with a diameter of 5 feet. In forest-grown specimens the trunk is usually long, clean, and with little taper, while in open-grown specimens it is usually short. Crown rather irregularly-oblong.

BARK—On young trunks (Fig. 115) rather smooth, glossy, reddish-brown, marked with conspicuous white horizontally-elongated lenticels; peels off in thin film-like layers, and exposes greenish inner bark. On old trunks (Fig. 116) blackish, roughened by thick irregular plates with projecting edges.

TWIGS—Smooth, rather slender, reddish-brown, marked with numerous, pale, round lenticels which in time become horizontally-elongated; pith white or light brown. Often covered with a thin, film-like, grayish coating which rubs off readily. Inner bark has a characteristic bitter taste and a rather pleasant odor.

BUDS—Alternate, about 1/8-1/6 of an inch long, ovate, usually sharp-pointed, smooth, glossy, reddish-brown, covered by about 4 visible ovate bud-scales which are sometimes coated with a smoky or grayish film-like skin. Lateral buds usually divergent but sometimes appressed, flattened, and larger than the terminal.

LEAVES—Alternate, simple, oblong or lanceolate-oblong, 2-5 inches long, tapering or rounded at base, taper-pointed at apex, serrate on margin with short incurved teeth, rather thick and shiny above, paler beneath.

LEAF-SCARS—Alternate, more than 2-ranked, raised on projections of the twig, semi-elliptical tendency in outline, with 3 bundle-scars.

FLOWERS—Appear in May or June; white, perfect, about ¼ of an inch across, borne in elongated drooping racemes 3-4 inches long.

FRUIT—A purplish-black juicy drupe, ⅓-½ of an inch in diameter, arranged in rather open drooping clusters; seed stony. Matures in summer.

WOOD—Diffuse-porous; rays very distinct; heartwood reddish-brown; sapwood narrow and yellowish; moderately heavy, hard and strong, fine-grained, does not warp or split in seasoning. Young wood is very durable. Its value is due to color and lustre and not to figure. Weighs 36 lbs. per cubic foot. Used principally in furniture and finish, also used for tools like spirit levels, implements, patterns, cores, and for high class panels.

DISTINGUISHING CHARACTERISTICS—The Wild Black Cherry, also known as Wild Cherry, Rum Cherry, Black Cherry, and Cabinet Cherry, may be distinguished from our other native species by its larger size and by the rough, dark, scaly bark which is found on the older trunks. For further distinguishing characteristics see Choke Cherry, page 173, and Fire Cherry, page 174. The introduced Domestic Cherry (Prunus avium) can be distinguished from this one by its stouter often grayish twigs, its smoother and shiny bark (Fig. 117) with conspicuous long and high lenticels and its clustered buds at the tips of stubby, lateral, spur-like branches. The fruit of the Domestic Cherry is larger than that of our native cherries and the leaves have rounded teeth often with glands and are frequently slightly pubescent on the lower side.

RANGE—Nova Scotia south to Florida, westward to South Dakota, Kansas, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State. Rather common but nowhere very abundant. Usually occurs solitary in mixture with other species. Magnificient specimens were present in the original forest of Potter county. Thrifty pure stands of young trees occur at present on the Hull State Forest in southern Potter county. The specimen of this species contained in the Jessup Wood Collection exhibited in the American Museum of Natural History, New York City, was procured in Wyoming county, Pennsylvania.

HABITAT—Thrives best on rich alluvial soil and fertile slopes. It will grow on dry and often rather sterile slopes. On account of its long tap-root it requires loose deep soil. Forester George Perry reports that this species suffers least from late frosts of all the native trees of southern Potter county.

IMPORTANCE OF THE SPECIES—The Wild Black Cherry is a very important timber tree, especially in the northern part of the State. Its wood is valuable especially for furniture and interior finish. Nowhere in its range has it ever been very abundant and on account of its prized wood it has been cut extensively. As a consequence it is now becoming rare, in fact marching towards extinction. It deserves to be planted extensively and to be protected carefully where it is found growing naturally.

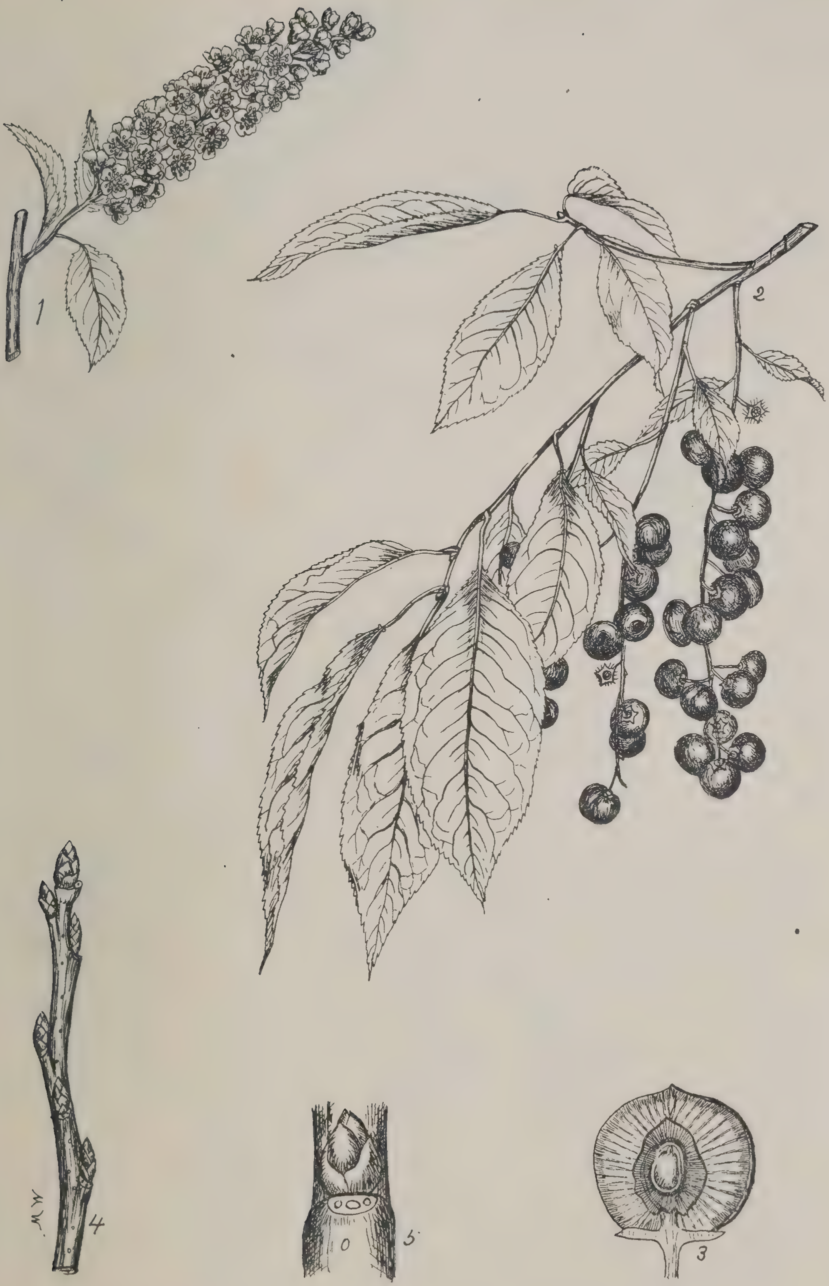

PLATE LXXXIV. WILD BLACK CHERRY

1. Section of a flowering branch, x ½.
2. A fruiting branch, x ½.
3. Section of a fruit, enlarged.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

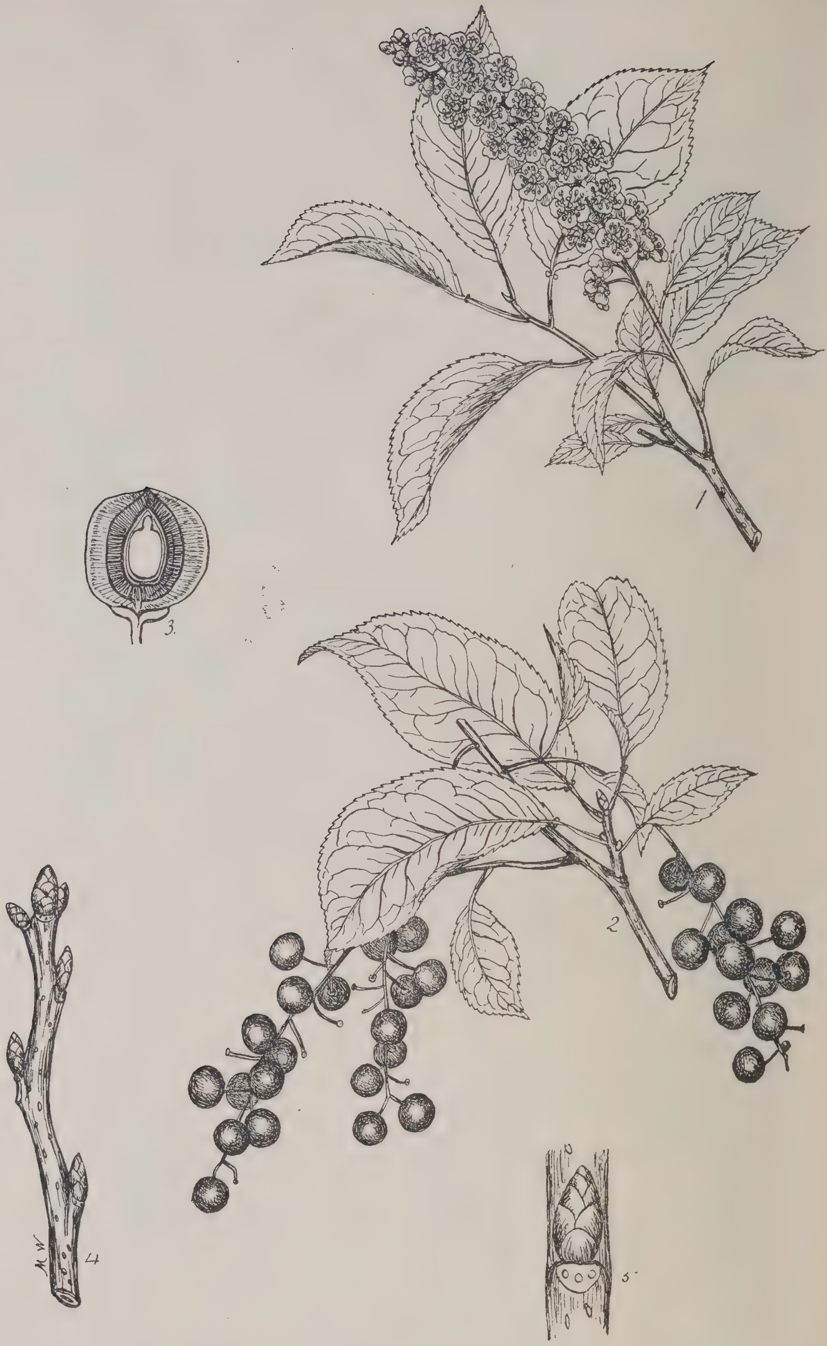

PLATE LXXXIV. WILD BLACK CHERRY

1. A flowering branch, x ½.
2. A fruiting branch, x ½.
3. Section of a fruit enlarged.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

CHOKE CHERRY

Prunus virginiana, Linnaeus

FORM—A small tree rarely exceeding 25 ft. in height with a diameter of 8 inches. It reaches its largest size in the southern part of its geographical range.

BARK—On young trunks smooth, shiny, brownish, peels off easily in thin film-like layers and exposes the green inner bark. On older trunks about 2/5 of an inch thick, dark grayish, slightly roughened by shallow fissures. Inner layers of the bark have a very disagreeable odor.

TWIGS—Rather stout, usually smooth, light brown to reddish-brown, covered with numerous, conspicuous, dull yellowish lenticels which are not evidently horizontally-elongated; pith white. Bruised twigs have a disagreeable odor.

BUDS—Alternate, about 1/6 of an inch long, conical to ovate, smooth, sharp-pointed, brownish, covered with about 6-8 visible and closely overlapping scales. Lateral buds are often rather divergent and larger than the terminal.

LEAVES—Alternate, simple, oval, oblong or obovate, 2-4 inches long, tapering or rounded at base, abruptly pointed at apex, sharply serrate on margin with slender teeth, rather thin, bright green above, paler below.

LEAF-SCARS—Alternate, more than 2-ranked, somewhat raised on projections of twigs with a tendency to become elliptical in outline. Bundle-scars 3 in number.

FLOWERS—Appear about May when the leaves are fully-developed. They are perfect, white, ½-⅓ of an inch across,arranged in many-flowered drooping racemes, 3-6 inches long.

FRUIT—A red to dark crimson juicy drupe, about ½ of an inch in diameter, arranged in rather open drooping clusters. Seed smooth and stony. Fruit is harsh and astringent.

WOOD—Similar to that of the Wild Black Cherry, page 172, only lighter in weight and portance. Not found on the market. Weighs 43 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Choke Cherry can be distinguished from the Wild Black Cherry by its smaller size, smoother and browner outer bark and an inner bark with a more disagreeable odor, as well as by its thinner and sharper serrate leaves with somewhat spreading slender teeth. The leaves of the Wild Black Cherry are thicker and moderately serrate with somewhat spreading slender teeth. The buds of the Wild Black Cherry are smaller and have rather uniformly-colored scales with a sharp apex while the buds of this species have grayish-margined scales with a rounded apex. This tree can be distinguished from the Fire Cherry by the absence of clustered terminal buds, by its stouter twigs, and by its flowers which are borne in a raceme while those of the Fire Cherry are borne in umbels. It can be distinguished from both the Wild Black Cherry and the Fire Cherry by its buff-colored lenticels which do not elongate horizontally.

RANGE—Newfoundland to Manitoba, southward to Georgia and Texas.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State but nowhere abundant. Most common in the mountainous and southeastern parts.

HABITAT—Frequently found in thickets, in open woods, along fences, in abandoned fields, along streams, and on dry situations.

IMPORTANCE OF THE SPECIES—The Choke Cherry is of no commercial importance. It is rather attractive in its natural habitat and when artificially planted. Even though it has no commercial value still it need not be regarded as an objectionable forest weed because it interferes little with the growth of other trees or their utilization.

FIRE CHERRY

Prunus pennsylvanica, Linnaeus

FORM—A small tree reaching a height of 40 ft. with a diameter of about 18 inches. Trunk usually short bearing rather ascending branches which form a narrow and rather flat-topped crown. The largest specimen the author has seen in Pennsylvania was growing upon the Hull State Forest, Potter county, and had a breast-high diameter of fourteen and one-half inches.

BARK—On old trunks somewhat roughened but not fissured. On younger trunks about ⅛ of an inch thick, reddish-brown, rather smooth but roughened by large horizontally-elongated lenticels. The outer barks peels off readily in thin film-like layers and exposes the green inner bark which is bitter.

TWIGS—Slender, smooth, glossy, bright red, sometimes wholly or partly covered with a thin grayish coating which rubs off very readily, marked with numerous pale to yellowish and conspicuous lenticels which in time become horizontally-elongated. The twigs have a characteristic bitter taste and a peculiar odor.

BUDS—Alternate, small, usually less than ⅛ of an inch long, ovate, dull-pointed, smooth or slightly grayish, scaly, clustered at the end of twigs and often along the sides; covered with scales which are hard to distinguish. They are sometimes clustered on stubby lateral spurs.

LEAVES—Alternate or sometimes paired but not opposite each other, simple, oblong-lanceolate, 3-5 inches long, tapering or rounded at base, sharp-pointed at apex, sharply and finely serrate on margin, rather shining, green and smooth on both sides.

LEAF-SCARS—Alternate, more than 2-ranked, somewhat raised on projections of twigs, elongated, semi-elliptical in outline, with 3 bundle-scars, the central one of which is usually the largest.

FLOWERS—Appear about May when leaves are partly developed. They are white, perfect, about ½ of an inch across, borne on long stalks in 4-5 flowered umbels.

FRUIT—A globular, juicy, light red drupe about ⅓ of an inch in diameter, tipped with parts of persistent styles, covered with thin skin which contains sour flesh and oblong stone. Ripens about July.

WOOD—Similar to that of the Wild Black Cherry, page 172, only lighter in weight and of no commercial importance. Not found on the market. Weighs 31 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Fire Cherry, also known as Wild Red, Bird and Pin Cherry, can be distinguished from Wild Black Cherry and Choke Cherry by its flowers which are borne in umbels while those of the other species are born in racemes, and by its slender twigs bearing clustered terminal buds while those of the other cherries occur solitary. The bark can be distinguished from the Choke Cherry by the presence of numerous orange-colored horizontally-elongated lenticels and from the Wild Black Cherry by the absence of dark scaly plates with projecting edges.

RANGE—Newfoundland to British Columbia, southward to Georgia, Tenessee, and Colorado.

DISTRIBUTION IN PENNSYLVANIA—Common in the mountainous parts of the State, particularly among the Alleghenies. Rare or absent southeast of a line drawn from Easton through Harrisburg to Chambersburg. Also rare in the western part of the State. The author has found only 12 specimens in the South Mountains of Adams, Cumberland, and Franklin counties during ten years of field work.

HABITAT—Usually found in rocky woods and recent clearings. Very common along fences and roadsides, in abandoned fields, on lumbered and burnt-over areas, on mountain slopes and occasionally found on bottomlands. Often forms almost impenetrable thickets in lumbered areas in the Allegheny Mountains. Three to five thousand specimens per acre is not an unusual number in the Black Forest region of northern Pennsylvania.

IMPORTANCE OF THE SPECIES—The Fire Cherry is of no commercial importance. It is very attractive but its short life prevents it from being planted extensively for ornamental purposes. It is rather aggressive, springing up rapidly after fires and lumbering operations, often taking complete control of the situation. It is, however, a temporary species acting as a shelter or nurse tree to other more valuable species which usually follow and form the desired forest stand. The main value of this tree lies in the shelter which it gives to others and the food which it furnishes for birds and wild animals.

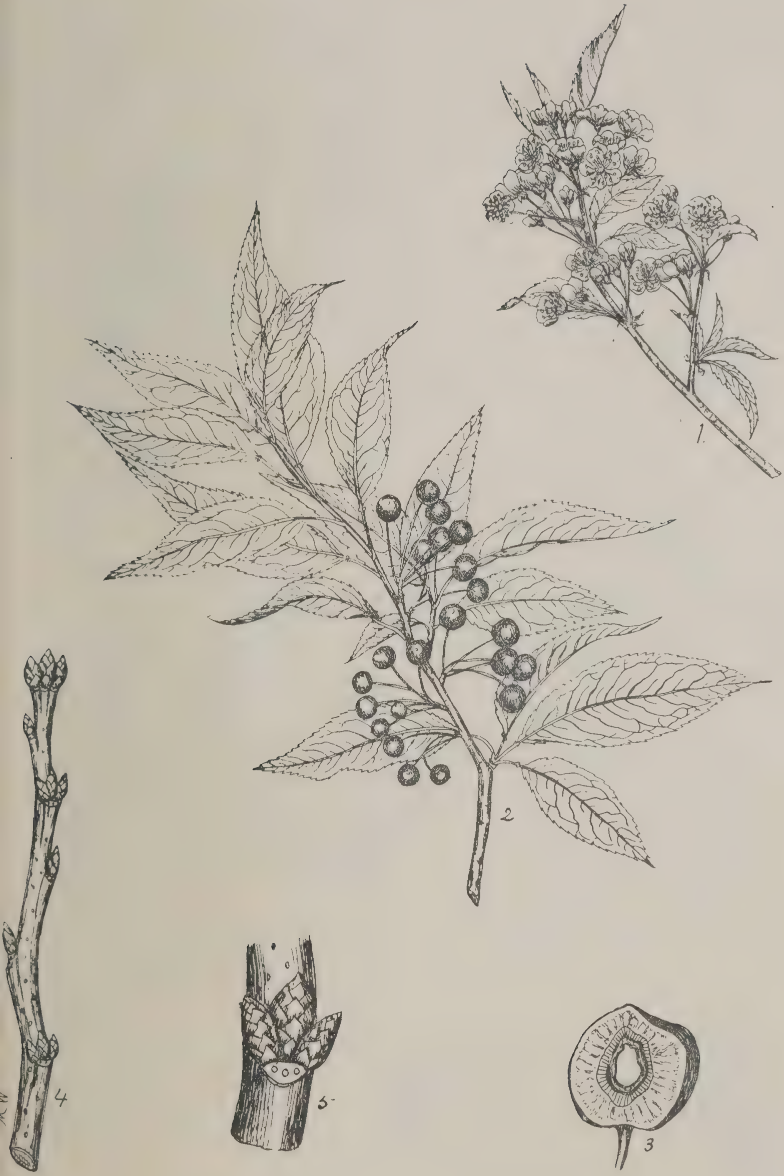

PLATE LXXXVI. FIRE CHERRY

1. A flowering branch, x ½.
2. A fruiting branch with mature leaves, x ½.
3. Section of a fruit, enlarged.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

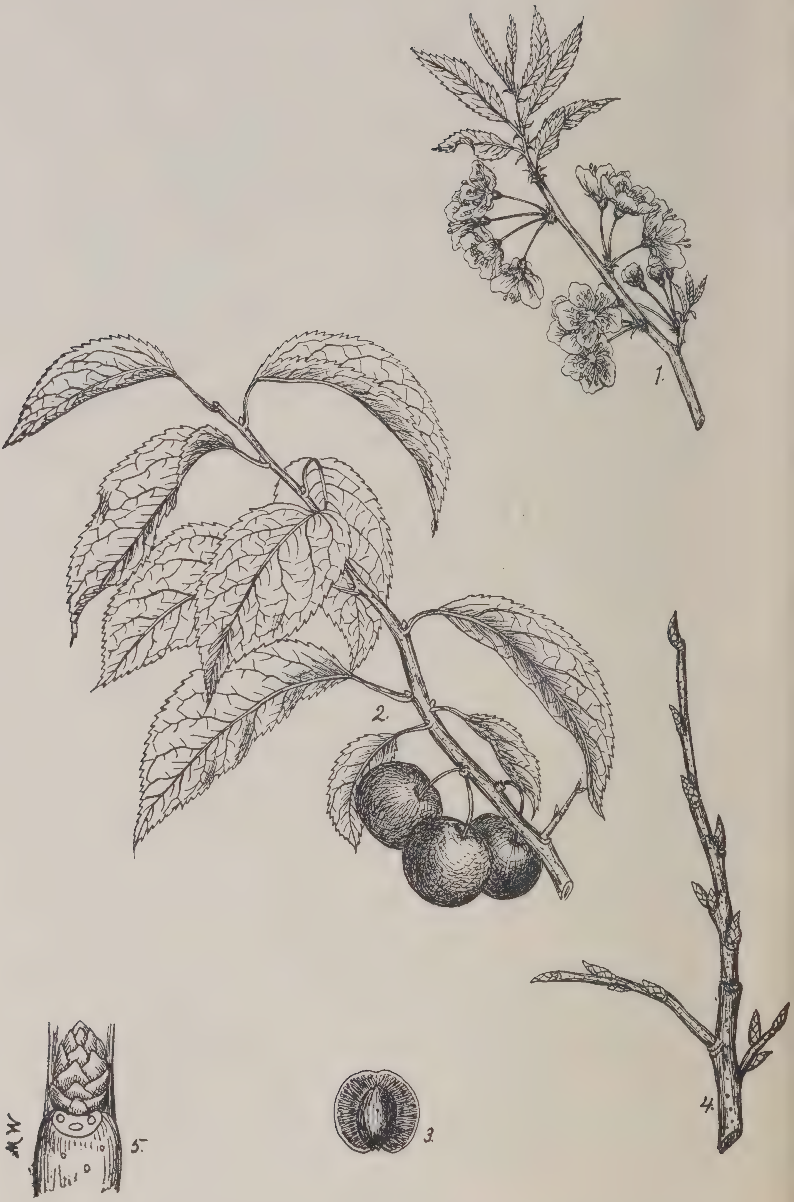

PLATE LXXXVII. WILD PLUM

1. A flowering branch, x ½.
2. A fruiting branch, x ½.
3. Section of a fruit, natural size.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.

WILD PLUM

Prunus americana, Marshall

FORM—A small tree from 9-30 ft. high with a diameter of 6-12 inches. Trunk short, bearing many wide-spreading, often drooping branches forming a deep and rather broad crown.

BARK—At first with a smooth grayish-brown bark, later becoming rough like the Wild Cherry by breaking up into thin dark brown plates.

TWIGS—Rather stout, at first hairy and light green, later smooth and reddish-brown, covered with a few roundish lenticels. Twigs often bear numerous spur-like spines.

BUDS—Alternate; terminal one absent; about ⅓ of an inch long, broadly conical, sharp-pointed, brown, covered with numerous triangular scales which are pale and hairy along the margin.

LEAVES—Alternate, simple, 1½-4 inches long, narrowly-obovate, taper-pointed at apex, usually rounded at base, sharply and doubly serrate on margin, firm, dark green, and rough above, paler and hairy below.

LEAF-SCARS—Alternate, more than 2-ranked, broadly crescent-shaped, with 3 conspicuous bundle-scars.

FLOWERS—Appear about May when the leaves are ⅓ developed. They are perfect, white, 1 inch across, occur on slender smooth stalks arranged in 2-5-flowered umbels.

FRUIT—Matures in late summer or early autumn. It is a subglobose drupe becoming red at full maturity, about 1 inch in diameter, with a thick tough skin and a flattened oval stone.

WOOD—Diffuse-porous; hard, heavy, strong, close-grained, reddish-brown, shiny, with thin sapwood. Weighs about 46 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Wild Plum, also known as the Wild Yellow Plum and Red Plum, can be distinguished from the other members of this genus here described by the absence of a terminal bud, by the characteristic bitter aromatic taste of the twigs and by its red globose fruit about 1 inch in diameter, covered with a thick tough skin and containing a smooth oval flattened stone. Another species of Plum known as Porters' Plum or Sloe (Prunus alleghaniensis), is native to this State. It is distinguished by its purple fruit which is usually covered with a bloom, rarely over ½ of an inch in diameter and seldom spiny.

RANGE—New York south to Florida, westward to Montana, Colorado, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State. Most common in the southeastern and southern parts, present but rarer in other parts.

HABITAT—Prefers rather moist rich soil. Common along banks of streams and borders of woods.

IMPORTANCE OF THE SPECIES—The Wild Plum is of no commercial importance on account of the timber which it produces, but it forms an excellent stock upon which to graft the Domestic Plum. It responds very readily to the attention which a gardener may give to it. The fruit is used for preserves and jellies. It is attractive ornamentally on account of its fine form, beautiful foliage, and profusion of attractive flowers.

COCKSPUR THORN

Crataegus Crus-galli, Linnaeus

GENUS DESCRIPTION—The genus Crataegus has the center of its distribution in eastern North America. It reaches its best development in the great limestone formations rather common in this part of America. Prior to 1900 fewer than 75 species were known in the world, of which number about 30 were native to North America. At the present time about 700 species of trees and shrubs belonging to this genus have been described. In the State of New York alone 218 species have been described. Porter, in his Flora of Pennsylvania, published in 1903, records 16 species as native to this State. Only 2 species are described in this bulletin because they are practically of no commercial importance and very difficult to identify.

FORM—A small tree sometimes reaching a height of 25 ft. with a diameter of 10-12 inches. Trunk short, bearing stout and spreading branches which form a broad and rather flat crown.

BARK—Grayish to reddish-brown, sometimes roughened by small scales.

TWIGS—Smooth, rather slender, at first greenish, later light brown to gray, usually bearing straight or slightly curved and unbranched chestnut-brown thorns about 3 inches long.

BUDS—Alternate, ⅛ of an inch long, often almost spherical, very blunt-pointed; terminal bud usually present and about the same size as the laterals. Lateral accessory buds are often found at the bases of thorns. Buds are covered with numerous, thick, blunt-pointed, chestnut-brown scales.

LEAVES—Alternate, simple, obovate to elliptical, 1-3 inches long, long-tapering at base, rounded or short-pointed at apex, sharply serrate on margin except towards base; smooth, thick, and shiny on the upper surface when full grown. Petioles short and broad.

LEAF-SCARS—Alternate, more than 2-ranked, small, crescent-shaped, containing 3 bundle-scars.

FLOWERS—Appear about June when leaves are fully developed. They are perfect, white, about ⅔ of an inch across and arranged in smooth corymbs.

FRUIT—Ripens about September but persists into winter. A globose or pear-like pome, about 2/5 of an inch long, greenish or dull red, with persistent calyx lobes at apex, containing small nutlets which are rounded at the ends and 2-3 grooved on the back.

WOOD—Diffuse-porous; rays very inconspicuous; growth rings variable in width and wavy; heavy, hard, reddish-brown, close-grained. Weighs about 45 lbs. per cubic foot. Used for fence posts and fuel.

DISTINGUISHING CHARACTERISTICS—The Cockspur Thorn, sometimes also known as Newcastle Thorn, Thorn Apple, Thorn, Hawthorn, and Haw, can best be recognized by its long, usually unbranched chestnut-brown thorns, its small nearly spherical buds, its obovate to elliptical leaves with short and flattened petioles, its flowers which are arranged in corymbs, and its bright, scarlet, apple-like fruit which often persists far into winter.

RANGE—Southern Canada and southward through Connecticut and Virginia to northern Georgia, westward to Michigan, Missouri, and Alabama.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southern parts of the State. Local in the other parts.

HABITAT—Common on sandy and gravelly soil. Most frequent on the foothills.

IMPORTANCE OF THE SPECIES—The Cockspur Thorn is of no commercial importance as a forest tree. It is, however, an attractive small tree which has been planted rather extensively for ornamental purposes. It is very variable in its form, leaves, flowers, and fruit. It has been planted as a hedge and in some cases has proved equal to the general requirements. The thorns were formerly used to close woolen sacks in carding mills.

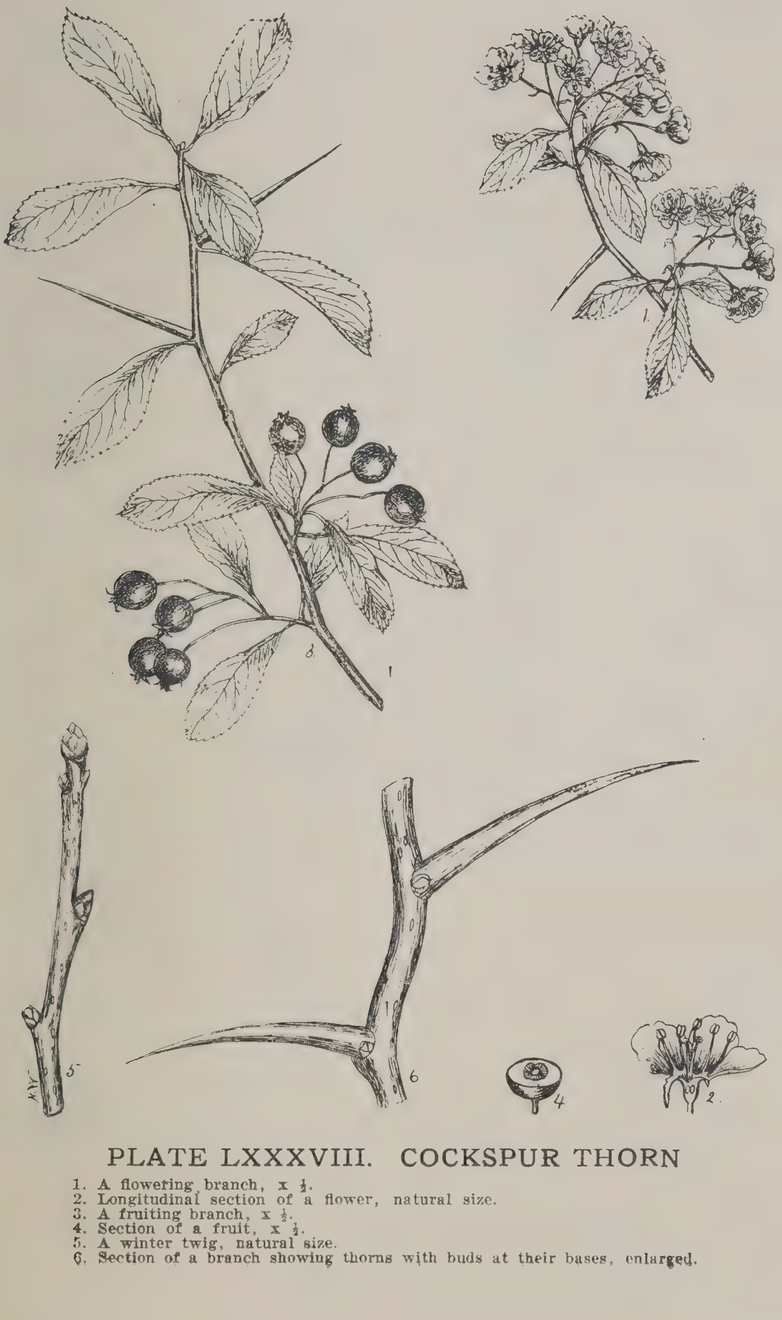

PLATE LXXXVIII. COCKSPUR THORN

1. A flowering branch, x ½.
2. Longitudinal section of a flower, natural size.
3. A fruiting branch, x ½.
4. Section of a fruit, x ½.
5. A winter twig, natural size.
6. Section of a branch showing thorns with buds at their bases, enlarged.

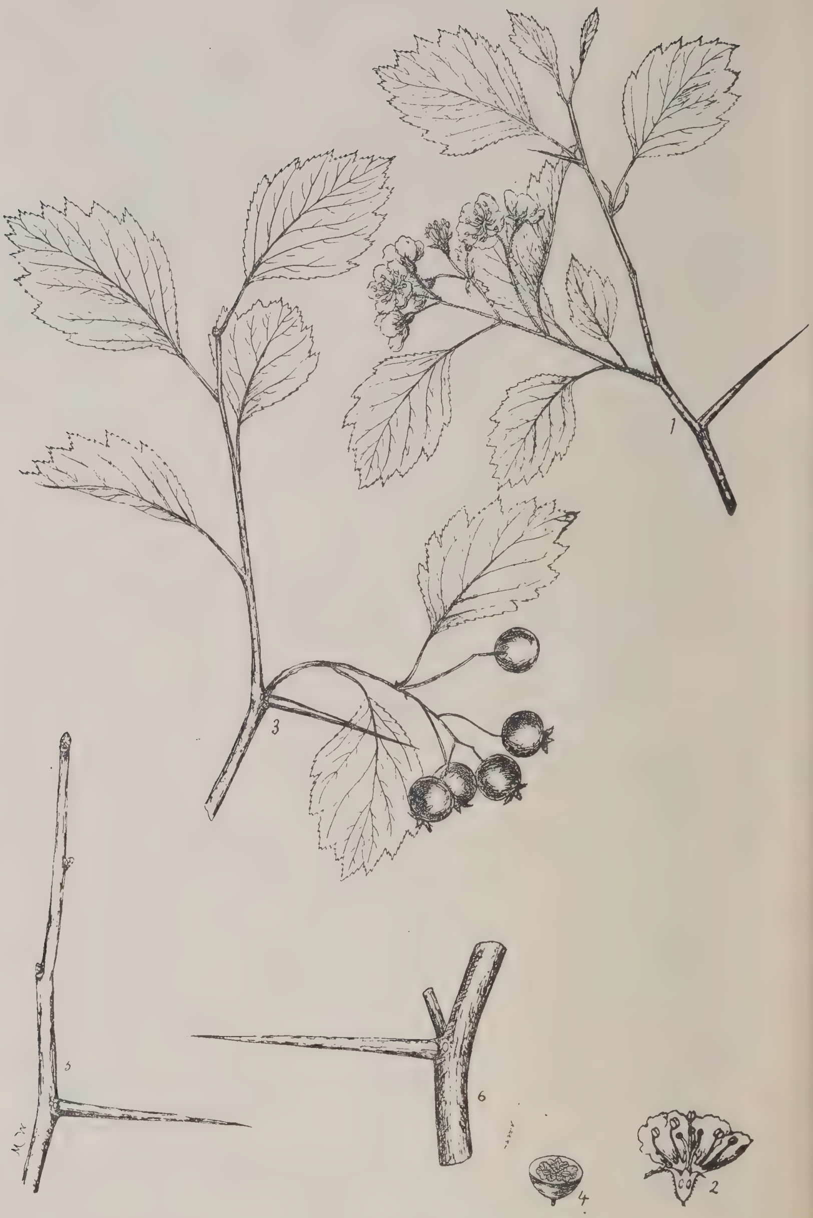

PLATE LXXXIX. SCARLET HAWTHORN

1. A flowering branch, x $\frac{1}{2}$.
2. Longitudinal section of a flower, natural size.
3. A fruiting branch, x $\frac{1}{2}$.
4. Section of a fruit, x $\frac{1}{2}$.
5. A winter twig with a thorn, x $\frac{1}{2}$.
6. Section of a twig showing a thorn and a bud by its base, slightly enlarged.

SCARLET HAWTHORN

Crataegus coccinea, Linnaeus

FORM—A small tree rarely exceeding a height of 20 ft. with a diameter of 10 inches. Trunk short, stout, bearing rather crooked spreading branches which form a broad and flat crown.

BARK—Rather thin, light brown to ashy-gray, in time roughened by shallow fissures separating small scales.

TWIGS—Stiff, round in cross-section, at first greenish, later reddish, brownish or grayish, glossy, armed with slender usually straight, brown, glossy spines about 2 inches long.

BUDS—Alternate, about ⅛ of an inch long, often almost spherical, very blunt-pointed, covered with numerous, thick, blunt-pointed, chestnut-brown scales. Terminal bud usually present and about same size as laterals. Lateral accessory buds are often found at the base of a thorn.

LEAVES—Alternate, simple, broadly ovate, 1-5 inches long, rough-pubescent, tapering, rounded or truncate at base, often slightly 5-9-lobed or deeply cut and finely serrate on margin, pointed at apex.

LEAF-SCARS—Alternate, more than 2-ranked, small, crescent-shaped, containing 3 bundle-scars.

FLOWERS—Appear about June when leaves are almost fully developed. They are perfect, white, ½-1 inch across, with disagreeable odor, arranged in few-flowered corymbs and borne on hairy and slender stalks.

FRUIT—Ripens in September or October and is arranged in small umbels. A subglobose to ellipsoidal pome, yellowish-green, later dark reddish-brown, pubescent, about 2/5 of an inch thick, crowned with calyx lobes; containing usually 3-4 nutlets.

WOOD—Similar to that of the Cockspur Thorn, page 176, only heavier and more valuable Used for canes, napkin rings, engraving blocks, rulers. The wood is of a high quality, taking a fine polish but the tree is small and scarce.

DISTINGUISHING CHARACTERISTICS—The Scarlet Hawthorn, also known as White Thorn, Scarlet Fruited Thorn, Thorn, Thorn Apple, and Hawthorn, can be distinguished by its broadly ovate leaves and reddish-brown globose fruit, both of which are pubescent. The leaves are 5-9-lobed or deeply cut and finely serrate. The small nearly spherical chestnut-brown buds and the slender usually straight thorns on the branches will aid in distinguishing it from most of our native species of trees. It is next to impossible to distinguish all the species of the genus Crataegus from each other.

RANGE—Eastern Massachusetts and Vermont, southward through New York and Pennsylvania to North Carolina.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State. Not so abundant in the northern and southwestern parts as elsewhere.

HABITAT—Usually found in rocky woods and old pastures with sandy or gravelly soil. Rather common along fences.

IMPORTANCE OF THE SPECIES—The Scarlet Hawthorn is of no commercial importance in the forest. It is, however, attractive on account of its flowers, autumnal color of its foliage, and the color of its persistent fruit.

AMERICAN CRAB APPLE

Pyrus coronaria, Linnaeus

GENUS DESCRIPTION—This genus embraces about 40 species of small trees and shrubs which inhabit the north temperate zone. About 10 species are native to North America and 6 to Pennsylvania. No important timber trees are members of this genus but some of our important fruit trees like the Apples and Pears belong here. Both our Common Pear and Common Apple have been introduced from Europe. Some authors make a distinct genus, Malus, for the Apples and another one, Sorbus, for the Mountain Ashes. Both are included under Pyrus in this publication.

FORM—A small tree which may attain a height of 25 ft. with a diameter of 14 inches. Trunk usually short and bearing rather slender, spreading, and crooked branches which form a rather broad round-topped crown.

BARK—Up to ½ of an inch thick, reddish-brown, roughened by longitudinal furrows which separate low ridges often covered with scales.

TWIGS—Rather stout, at first white-woolly, later smooth, reddish-brown, after first year bearing stubby spurs or sometimes sharp spines.

BUDS—Alternate, about ⅛-¼ of an inch long, bright red, blunt-pointed or on vigorous terminal shoots sharp-pointed and curved, covered with 4-8 visible scales.

LEAVES—Alternate, simple, ovate or elliptical, 3-4 inches long, usually rounded at base, sharp-pointed at apex, sharply serrate on margin, usually smooth, dark green above, pale green below. Stipules long, falling early.

LEAF-SCARS—Alternate, raised on projection of twigs, crescent-shaped; with usually 3 conspicuous bundle-scars.

FLOWERS—Appear in May or June when the leaves are almost fully developed. Perfect, fragrant, rosy-white, about 1½-2 inches across, arranged in umbel-like cymes. The flowers as a whole resemble those of the Common Apple.

FRUIT—Ripens about October. Pome or apple-like, borne on long slender stalks, depressed-globose, 1-1½ inches in diameter, crowned with persistent calyx lobes and filaments, yellowish-green, fragrant. The flesh is clear and heavily charged with bitter malic acid. Seeds chestnut-brown and shiny.

WOOD—Diffuse-porous; rays not distinct; hard, heavy, light reddish-brown. Weighs about 40 lbs. per cubic foot. Used for carving, engraving, tool handles, and some turned articles.

DISTINGUISHING CHARACTERISTICS—The American Crab Apple closely resembles our cultivated apple, only the leaves of the former are smoother, the flowers more brilliant red, and the fruit smaller and very bitter. The fruit often persists far into winter and does not rot readily. It can be distinguished from the closely related Narrow-leaved Crab Apple (Pyrus angustifolia, Ait.) by its persistent calyx-lobes on the fruit, and by its ovate leaf-blades while those of the latter are usually lanceolate.

RANGE—Ontario south through South Carolina to Alabama, west to Michigan, Missouri and northern Louisiana.

DISTRIBUTION IN PENNSYLVANIA—Common in the southwestern part of the State. Local outposts reported from the central and western parts of the State. Peter Kalm, a pupil of Linnaeus, who traveled in America in 1753, reported this species "plentiful in Pennsylvania." It is, however, not very abundant at the present time. In many localities it is unknown and in others only a few specimens occur.

HABITAT—Usually found in thickets and open woods where rich moist soil is present. Probably occurs most frequently on little hill-tops near streams and ponds.

IMPORTANCE OF THE SPECIES—The American Crab Apple is of no commercial importance as a forest tree. It rarely exceeds 25 ft. in height. The fruit is used for jellies and for cider. It is a most attractive ornamental tree on account of its showy and fragrant flowers produced in great profusion.

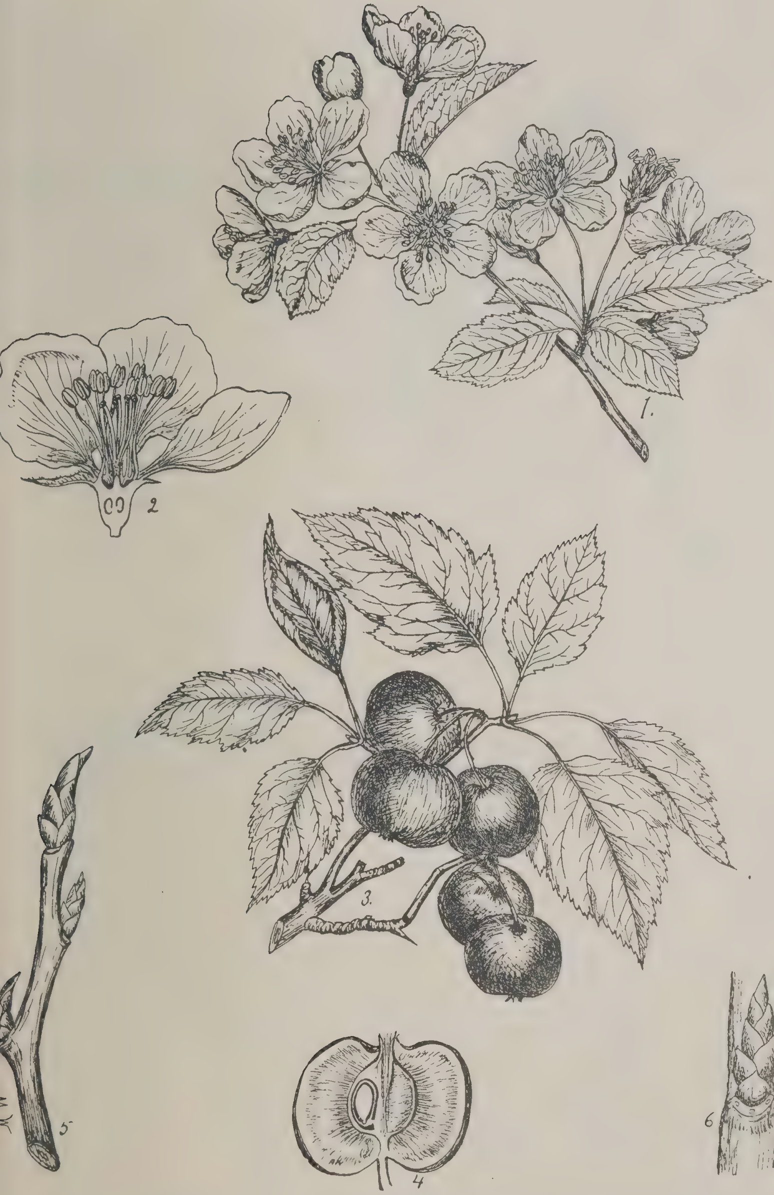

PLATE XC. AMERICAN CRAB APPLE

1. A flowering branch, x ½.
2. Longitudinal section of a flower, enlarged.
3. A fruiting branch, x ½.
4. Section of a fruit natural size.
5. A winter twig, natural size.
6. **Section of a winter twig, enlarged.**

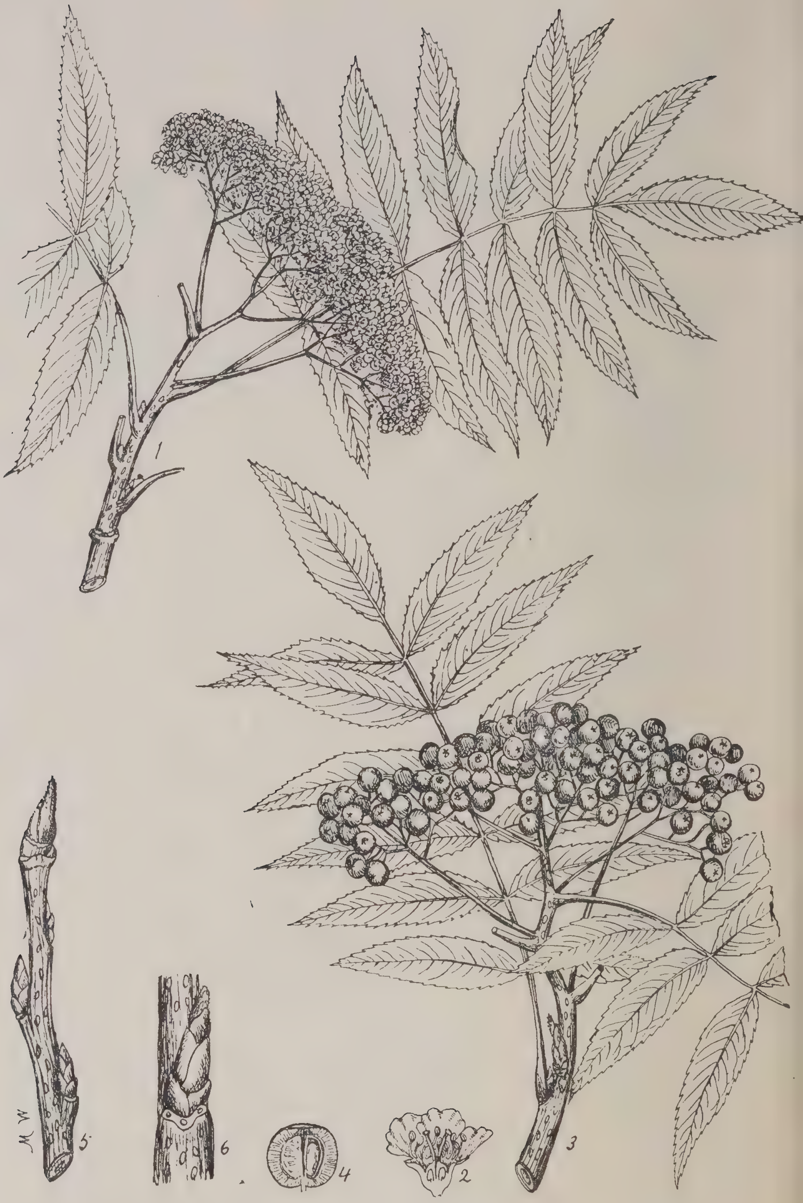

PLATE XCI. AMERICAN MOUNTAIN ASH

1. A flowering branch, with leaves, x ½.
2. Longitudinal section of a flower, enlarged.
3. A fruiting branch, x ½.
4. Section of a fruit, enlarged.
5. A winter twig, natural size.
6. Section of a winter twig, enlarged.

AMERICAN MOUNTAIN ASH

Pyrus americana, (Marshall) De Candolle

FORM—A small tree exceeding 20 ft. in height with a diameter of 12 inches. A tree 14 inches in diameter is reported from Lycoming county. Trunk rather short and the crown narrow and round-topped.

BARK—Thin, smooth or slightly scaly and grayish.

TWIGS—Rather stout, smooth, grayish to reddish-brown, covered with conspicuous, pale, oblong lenticels, pith large, brownish.

BUDS—Alternate, purplish-red, smooth or slightly hairy on outside but densely hairy on inside; terminal buds large, about ¼ of an inch long, broadly conical, with 2-3 visible bud-scales, sharp-pointed and often curved at apex; lateral buds about ⅛ of an inch long, closely appressed, somewhat flattened, with 1-2 visible bud-scales.

LEAVES—Alternate, compound, 6-10 inches long, with 13-17 sessile leaflets. Leaflets in pairs except terminal one, lanceolate, 2-3 inches long, sharp-pointed at apex, serrate on margin, tapering or rounded at base. Smooth and dark yellowish-green when full grown, turning yellow in autumn.

LEAF-SCARS—Alternate, rather large, elevated on a projection of the twig, broadly U-shaped, with wavy margin, containing 3-5 bundle-scars.

FLOWERS—Appear about May when the leaves are fully developed. They are white, perfect, about ⅛ of an inch across, arranged in flat cymes 3-4 inches across.

FRUIT—Arranged in flat-topped clusters, persisting far into winter, berry-like, about the size of a medium-sized cherry, bright red, round or pear-shaped, in winter wrinkled, its flesh strongly acid.

WOOD—Diffuse-porous; rays indistinct; soft, weak, brownish, close-grained. Weighs about 34 lbs. per cubic foot. Not used commercially.

DISTINGUISHING CHARACTERISTICS—The American Mountain Ash can be distinguished by its alternate compound leaves with 13-17 sessile leaflets which are conspicuously toothed. The flat-topped cymes of white flowers measuring about 3-4 inches across, and the bright red fruit about the size of a pea and arranged in flat-topped clusters are characteristic. The stout grayish to reddish-brown twig with conspicuous pale lenticels and the purplish-red, sharp-pointed, somewhat gummy and usually smooth alternate buds are also characteristic.

RANGE—Newfoundland westward to Manitoba and Iowa, southward in the mountains to North Carolina.

DISTRIBUTION IN PENNSYLVANIA—Limited to the mountainous region of the State. A line drawn from the western part of Tioga county south to Somerset county, east to Bedford county, and thence northeast to Monroe county will include the general distribution of this tree. A small patch occurs on top of Martin's Hill (elevation 3,000 feet) in Bedford county. The larger specimens are 8 inches in diameter. In 1916 these trees produced a heavy crop of seeds. Very abundant in Bear Meadows, Centre County. The largest known mountain ash in Pennsylvania stands near Daleville, Covington township, Lackawanna county. It is 50 feet high and 24 inches in diameter.

HABITAT—Prefers moist or rocky hillsides. Often found on the border of streams and locally common on rocky hillsides.

IMPORTANCE OF THE SPECIES—The American Mountain Ash is of no commercial importance. It rarely exceeds a height of 20-25 ft. with a diameter of 12-15 inches. It is rather attractive and deserves to be planted for ornamental purposes. Its attractive ornamental features are its form, board cyme-like clusters of white flowers, and its bright red clusters of fruit which ripen in autumn.

SHAD BUSH

Amelanchier canadensis, (Linnaeus) Medicus

GENUS DESCRIPTION—The genus Amelanchier comprises about 30 species of small trees and shrubs found mainly in the temperate portion of the northern hemisphere. About 23 species are found in North America, 6 of which attain tree-size. Four species are native to Pennsylvania, only 1 of which attains tree-size.

FORM—A small tree usually 10-25 ft. in height with a diameter of 6-12 inches but may reach a height of 40 ft. with a diameter of 20 inches. Trunk usually straight, slender, with little taper, bearing a shallow and narrow crown appearing very dense on account of abundant fine sprays of branchlets.

BARK—Rather smooth on young and old specimens. On older specimens there is a tendency to roughen through shallow, longitudinal, sometimes diagonal fissures which are rather dark and seperate broad, lighter, and smooth ridges becoming scaly near the base.

TWIGS—Slender, somewhat zigzag, bright green to purplish-brown, smooth or often overlaid with a grayish film-like coating which peels off; covered with a few, pale, scattered lenticels; pith small, greenish, angular.

BUDS—Alternate, usually 2-ranked, slender, conical, ¼-½ of an inch long, 3-4 times as long as broad, sharp-pointed, greenish-brown often tinged with purple, sometimes smooth, often hairy towards apex and along bud-scales. Terminal buds longer than lateral which are usually appressed close to twig, sometimes remaining very small. Bud-scales largest near base, often 3-nerved, darker and finely hairy along margin.

LEAVES—Alternate, simple, ovate to ovate-oblong, 3-4 inches long, sharp-pointed at apex, round or heart-shaped at base, finely and sharply serrate on margin, at first hairy, later smooth, dark green above, paler below.

LEAF-SCARS—Alternate, usually 2-ranked, small, inconspicuous, rather linear, with projecting bundle-scars which are large and 3 in number.

FLOWERS—Appear about April when leaves are just starting to develop; large, white, perfect, stalked, arranged in drooping racemes 3-5 inches long.

FRUIT—Matures in June or July. Berry-like in racemes, reddish-purple, with a bloom when fully ripe, about ⅓ of an inch in diameter, sweet, and containing small seeds.

WOOD—Diffuse-porous; rays numerous, indistinct, dark brown often touched with red; heavy, hard, strong, checks and warps easily, very susceptible to high polish. Weighs 49 lbs. per cubic foot. Used to a limited extent, mainly in turnery.

DISTINGUISHING CHARACTERISTICS—The Shad Bush, also known as Service Berry, June Berry, and Sarvice, can readily be distinguished in winter by its smooth, grayish often black-streaked bark and its long, slender, conical, sharp-pointed, greenish-brown to purplish buds which are often finely hairy towards the apex and along the margin of the scales. The buds, in form and to some extent in size, resemble the Beech but the buds of the Beech are usually larger, clear, reddish-brown in color and have from 10-20 scales arranged in 4 rows. The twigs of the Beech are shining reddish-brown while those of the Shad Bush are usually bright green to grayish or purplish-brown. The stipule scars are absent on the Shad Bush while they nearly encircle the twig of the Beech. The large white flowers arranged in drooping racemes 3-5 inches long are also characteristic. The leaves and the fruit will aid in distinguishing it in summer.

RANGE—Newfoundland and Ontario, southward to Florida, westward to Kansas and Louisiana.

DISTRIBUTION IN PENNSYLVANIA—Found in every portion of the State. Most abundant among the mountain ranges. The largest Shad Bush reported in Pennsylvania stands in Maple Hollow near Duncansville, in Blair county. It is over 66 inches in circumference at 4 feet from the ground.

HABITAT—Occurs solitary or occasionally in clumps. Prefers open situations and moist soil, but also grows on sandy rather sterile soil. Common along border of forests, banks of streams, forest roads, and cliffs. Small specimens common in the understory of our hardwood forests.

IMPORTANCE OF THE SPECIES—The Shad Bush is of little commercial importance because its wood is rarely used. It will always be a minor species not on account of the inferiority of its wood but on account of its small size and limited and scattered distribution. The wood is actually stronger and stiffer than White Oak. Its conspicuous white flowers in early spring before the leaves are out justify its retention in the forest, especially where it does not interfere with the growth of other more valuable trees. The berries are excellent food for birds, beasts, and man.

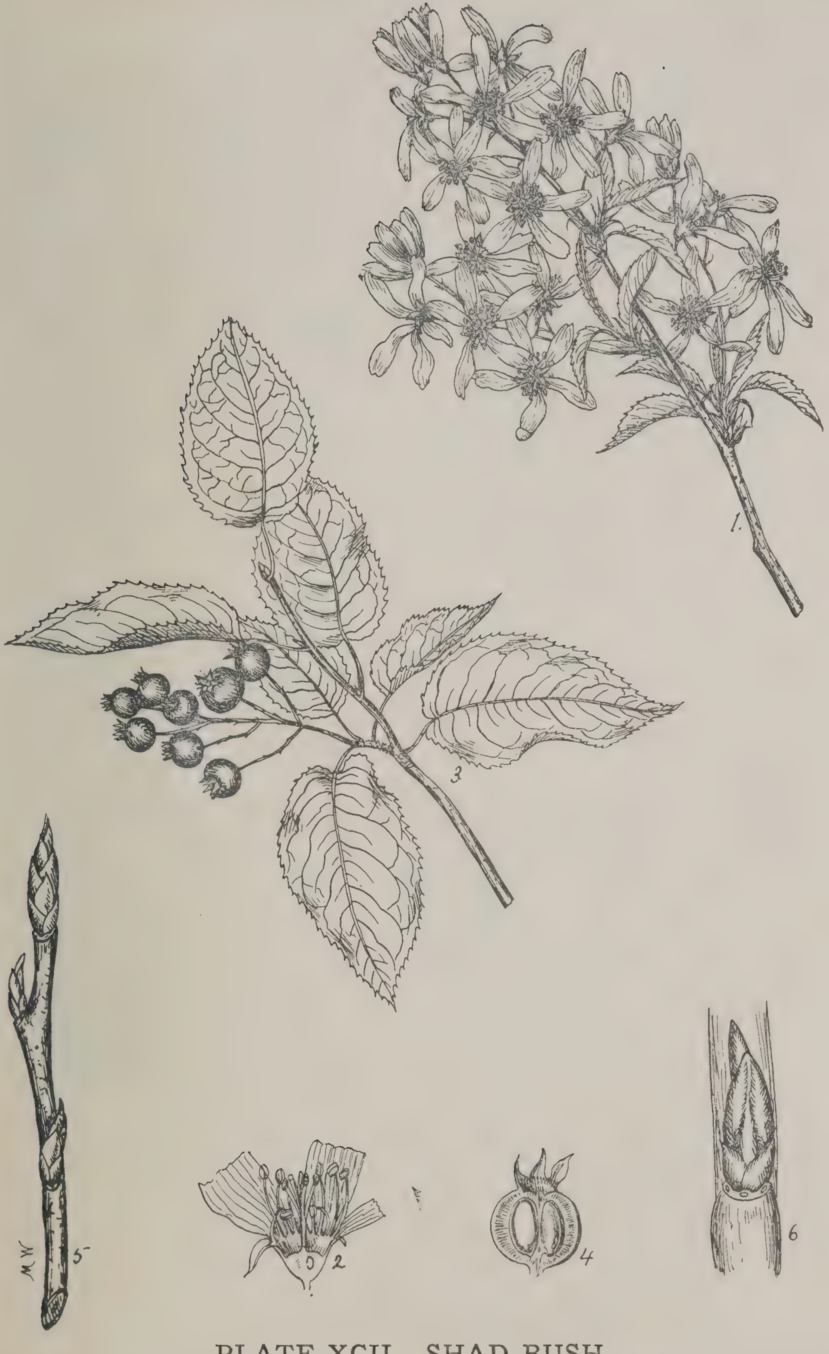

PLATE XCII. SHAD BUSH

1. A flowering branch, x ½.
2. Longitudinal section of a flower, enlarged.
3. A fruiting branch with mature leaves, x ½.
4. Section of a fruit, enlarged.
5. A winter twig, natural size.
6. Section of a winter twig, enlarged.

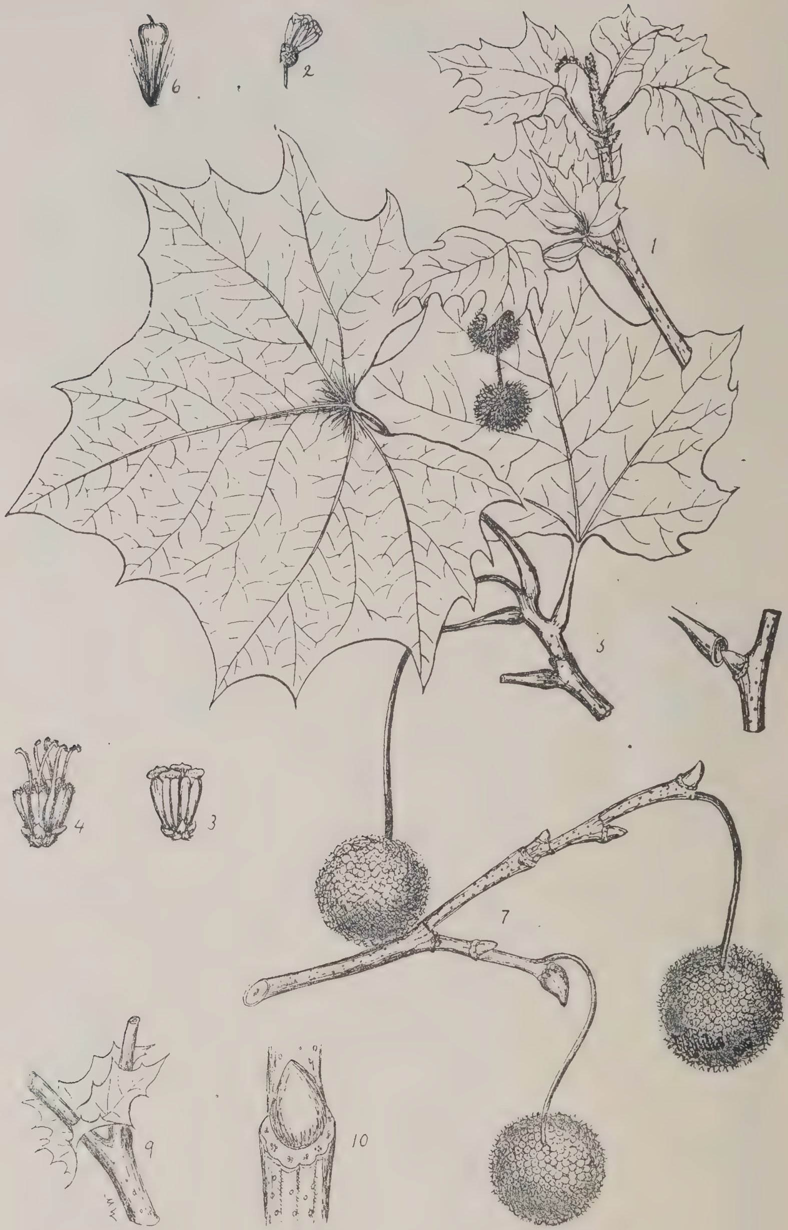

PLATE XCIII. BUTTONWOOD

1. A flowering branch, x ½.
2. A head of flowers with most of the flowers removed, x ½.
3. A staminate flower, enlarged.
4. A pistillate flower, enlarged.
5. A fruiting branch with mature leaves, x ½.
6. An achene, enlarged.
7. A winter twig with two heads of fruit, x ½.
8. Section of a twig showing a subpetiolar bud, x ½.
9. Section of a twig showing a stipule, natural size.
10. Section of a winter twig, enlarged.

BUTTONWOOD

Platanus occidentalis, Linnaeus

FAMILY AND GENUS DESCRIPTION—The Plane Tree family, Platanaceae, comprises only 1 genus, Platanus, with about 7 species, 3 of which are native to the United States and 1 to Pennsylvania. In addition to the 1 species native to this State, the Old World Plane Tree (Platanus orientalis L.) is very commonly planted as a shade tree in the eastern states.

FORM—Usually attains a height of 70-125 ft., but may reach a height of 140-170 ft. with a diameter of 10-11 feet. It is the most massive of the deciduous trees of North America. Trunk usually branches near the base into heavy sub-trunks, which sub-divide and form a very deep, wide-spreading, rather open, and irregular crown.

BARK—On old trunks rather thick, rigid, roughened by shallow fissures separating broad ridges which peel off into thin dark brown scales. On young trunks and upper parts of old ones it peels off spontaneously into large thin plates exposing a whitish, yellowish, or a greenish inner bark. This mottled inner bark is characteristic, but rarely found near the ground. See Fig. 76.

TWIGS—Rather stout, zigzag, at first green and pubescent, later brownish to gray and smooth, decurrently ridged, enlarged at the nodes, marked by numerous, small, pale lenticels, encircled by stipule-scars. Pith wide and white.

BUDS—Alternate; terminal bud absent; sub-petiolar, surrounded by base of leaf-stalk or leaf-scars, ⅛-⅜ of an inch long, conical, dull-pointed, very divergent from section of branch above and slightly from section below, covered with 3 scales, the outer one of which is smooth, shining, reddish-brown, the middle green and gummy, and the inner pubescent.

LEAVES—Alternate, simple, broadly ovate, 3-5-lobed, toothed on margin, 4-10 inches across, bright green above, pale green and white woolly below. Petioles about 2 inches long, round, with enlarged hollow bases. Stipules 1½ inches long, conspicuous, encircling twig.

LEAF-SCARS—Alternate, 2-ranked, unequal in width, have a wavy outer margin, nearly encircle the buds at enlarged nodes of branches, form an angle of about 60 degrees with the section of branch below, contain 5-10 bundle-scars which are arranged in a curved line and occur singly or in groups.

FLOWERS—Appear in dense heads with the leaves in May. Staminate and pistillate flower heads occur on different stalks. Staminate are axillary and dark red; pistillate terminal, greenish and often tinged with red.

FRUIT—Matures in October. Occurs solitary or rarely in 2s in brown heads about 1 inch in diameter suspended from a slender stalk. Heads often persist far into winter and are composed of many hairy achenes about ¾ of an inch long.

WOOD—Diffuse-porous; rays conspicuously broad; pores minute; hard, difficult to split, reddish-brown with light to yellowish sapwood. Weighs 35 lbs. per cubic foot. Used in the manufacture of furniture, interior furnishing, crates, tobacco boxes, and charcoal.

DISTINGUISHING CHARACTERISTICS—The Buttonwood, also known as Buttonball, Sycamore, and Plane Tree, can readily be distinguished in summer by its massive form, its whitish, yellowish, or greenish bark of the upper branches which at times are covered with large, thin, dark brown scales of outer bark. The large leaves with their enlarged hollow-based petioles and the flowers in the form of heads, are also characteristic. In winter the massive form and whitewashed appearance of the upper branches is distinctive. The smooth-reddish, sub-petiolar buds covered by a single exposed scale and surrounded by a leaf-scar with 5-10 bundle-scars will prevent one from confusing it with any other of our native trees. The persistent fruit which usually occurs solitary is readily distinguished from the oriental species which bears its fruit in clusters of 2-4.

RANGE—Maine and Ontario south to Florida, west to Minnesota, Nebraska, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common along streams, especially in the eastern, southern, western, and central parts of the State. Rare along the streams in the north-central part. Only a few specimens found along the headwaters of such streams as the Sinnemahoning and Pine Creeks, and other streams of northern Pennsylvania. Many massive Sycamore trees occur in Pennsylvania. The most massive tree in the State stands about 4 miles west of Lancaster, at eighteen inches above the ground. This Buttonwood tree measures over 27 feet in circumference at the ground and at five feet from the ground is over 22 feet in circumference. It has a height of 102 feet and a branch spread of 138 feet.

HABITAT—Prefers moist, fertile soil, but will grow in rather dry soil. Best development in the moist valleys of the Ohio and Mississippi rivers.

IMPORTANCE OF THE SPECIES—The wood of the Buttonwood is annually becoming of more commercial importance and hence it should be planted at least to a limited extent. It may be grown from cuttings or from seed. It is planted sparingly for ornamental purposes but the Oriental Sycamore seems to be preferred since it is more attractive and less subject to fungous diseases.

THE PULSE FAMILY—LEGUMINOSAE

This is a very large family and contains many well-known trees. shrubs, and herbaceous plants. It comprises about 460 genera with 7,350 species of which number more than 100 genera with about 1,400 species are native to North America. The flora of Pennsylvania comprises about 32 genera with approximately 90 species but only 4 species belonging to 4 different genera can be classified as trees. Some authors separate the members of this family into 3 distinct families known as: (1) The Mimosa family, Mimosaceae, (2) The Senna family, Caesalpiniaceae, and (3) The Pea family, Fabaceae.

Many domestic and foreign plants which belong to this family are of considerable economic importance. Some of our native trees produce very heavy, hard, and strong wood. They possess additional merits in that they grow rapidly and are well adapted to artificial propagation. Some of them, in particular the Common Locust, are subject to the attack of destructive insects and fungi. Some of the shrub members of this family are among the most attractive that one can find for ornamental planting. The herbaceous members comprise some of the commonest and most valuable food and forage plants of the world, such as the peas, beans, clover, and the common peanut. Among the valuable products which some of the foreign members of this family produce one can mention Senna and Logwood. Senna is prized on account of its laxative properites and is derived from the leaves of a few African species of Cassia. Logwood, the most important of vegetable dyes, is derived from the heartwood of the trunk and roots of a tree growing in the West Indies and Central America. Indigo, one of our important and widely used dyes, is also obtained from a member of this family. The well-known Sensitive Plant (Mimosa pudica L.) so common in our greenhouses and a mere weed in the tropics is one of the most widely known and interesting representatives of this family. In addition they comprise a great number of plants which are important on account of the medicinal properties derived from them. Probably one of the greatest values which we can attach to some of the members of this family is the means which they have at their command for restoring nitrogen to barren land. If one examines the roots of clover, alfalfa, soy bean, or the Common Locust he may find little swellings or enlargements upon them known as root tubercles. These swellings are caused by bacteria which posses the power of taking free nitrogen from the air and by means of complicated chemical changes passing it to members of this family. As a result these plants can be grown upon soils very deficient in nitrates. In addition they will return sufficient nitrogen to the soil so that companion or subsequent crops will thrive which would have barely existed without the nitrogen. The Common Locust often thrives on old abandoned mud-dams found about ore mines while other aggressive trees fail even to establish themselves.

The members of this family are distinctly characterized by their fruit which matures in one season and usually resembles ordinary garden beans or peas. The fruit of some of the trees found in the western part of North America varies more or less from the typical bean-like fruit pod. The flowers of our native trees may be *irregular* in form, i. e. pea-like or bean-like, as in the Common Locust and Redbud, or *regular* in form as in the Honey Locust and Kentucky Coffee Tree. The two native tree-species with irregular flowers have also perfect flowers, i. e. flowers with both the male (pollen producing) and female (seed producing) organs in the same flower while the other two native tree-species have regular but imperfect flowers, i. e. flowers with one sex so suppressed that only the other sex remains in each flower. Whenever the male and female flowers, also known as staminate and pistillate flowers respectively, occur separately, they may be found on the same branch, or on the same tree, or on different trees. The leaves of nearly all the tree members of this family are alternate and compound, but a few such as our native Redbud have simple leaves. Some species as our Common Locust are normally only once compound, others as the Honey Locust may be once or twice compound, while still others, as the Kentucky Coffee Tree, may be normally twice compound.

SUMMER KEY TO THE GENERA

Page

1. Leaves simple; twigs slender and unarmed, ... Cercis 186
1. Leaves compound; twigs stout or armed with spines or thorns, ... 2
2. Twigs very stout and clumsy but not armed with spines or thorns; fruit-pods woody; leaves twice compound, from 1-3 ft. long, ... Gymnocladus 184
2. Twigs relatively slender and armed with spines or thorns; fruit-pods leathery; leaves usually once or sometimes twice compound, rarely over 1 ft. long, ... 3
3. Flowers greenish, regular or nearly so, imperfect, in axillary spikes; leaves once or twice compound, even-pinnate; twigs, branches, and often trunks armed with long branched thorns, ... Gleditsia 185
3. Flowers whitish, irregular, perfect, and occur in drooping racemes; leaves usually once compound, odd-pinnate; twigs often with two short spines at nodes, ..Robinia 187

WINTER KEY TO THE GENERA

1. Twigs, branches, and trunks usually armed with spines or thorns, ... 2
1. Twigs, branches, and trunks without spines or thorns, ... 3
2. Twigs and branches armed with a pair of spines not exceeding ½ of an inch in length at each node;fruit-pods 2-4 inches long, ½ of an inch broad; bark reddish-brown, even on young trunks deeply furrowed, ... Robinia 187
2. Twigs, branches, and often trunks usually armed with thorns which occur singly, are often branched and usually much exceed ½ of an inch in length; fruit pods 10-18 inches long, 1-1½ inches wide; bark grayish-brown to black, not furrowed, often covered with conspicuous oblong lenticels, ... Gleditsia 185
3. Twigs, stout, clumsy, blunt-pointed, with large conspicuous bundle-scars and large pink to brown pith; fruit-pods thick, woody, stubby, contain fleshy pulp and large seeds; buds silky-pubescent, depressed, uppermost one surrounded by incurved hairy ring of bark, ... Gymnocladus 184
3. Twigs slender, not clumsy nor blunt-pointed, with inconspicuous bundle-scars and pith with reddish longitudinal streaks; fruit-pods very thin, leathery, without fleshy pulp, and contain small seeds; buds smooth, not depressed, often somewhat flattened and appressed, ... Cercis 186

KENTUCKY COFFEE-TREE

Gymnocladus dioica, (Linnaeus) Koch

GENUS DESCRIPTION—This genus comprises only 2 species, one Gymnocladus chinensis, a native of southern China, and the other described here. The generic name Gymnocladus is of Greek origin and means "naked branch," referring to the stout clumsy branches which are devoid of foliage for about 6 months of the year.

FORM—A medium-sized tree usually 40-80 ft. in height with a diameter of 1-2 ft. but may reach a height of 100 ft. with a diameter of 3 feet. Trunk usually short, soon subdividing into 2 to 4 nearly parallel and vertical secondary stems. Crown narrow, obovate, composed of very stout branchlets.

BARK—Of medium thickness, dark gray to dark brown, roughened by shallow fissures separating low but sharp and horny ridges covered with thin recurved scales.

TWIGS—Very stout, blunt-pointed, greenish-brown, often coated with a whitish crusty film, occasionally covered with fine hairs, and marked with large conspicuous lenticels usually most numerous on the second years' growth. Pith large, pink to brown in color.

BUDS—Alternate; terminal bud absent; small, downy, imbedded in twig so that they scarcely project beyond surface, surrounded by incurved hairy ring of bark, superposed. The uppermost bud is the largest; the lowest is small and located in the depression at top of leaf-scar.

LEAVES—Alternate, twice compound, 1-3 ft. long, 1½-2 ft. broad, with 7-13 foliate pinnae; 1-2 basal pairs of pinnae are reduced to entire leaflets. Pinnae have 3-7 pairs of leaflets. Leaflets ovate, 2-2½ inches long, wedge-shaped to rounded at base, sharp-pointed at apex, entire to wavy on margin.

LEAF-SCARS—Alternate, more than 2-ranked, large, conspicuous, raised on projections of twigs, broadly heart-shaped, paler in color than surrounding twig; contain 3-5 large, raised bundle-scars.

FLOWERS—Appear about June. Regular, polygamus, or dioecious by abortion. Staminate flowers greenish-white and arranged in a raceme-like corymb about 3-4 inches long. Pistillate flowers greenish-white and arranged in terminal racemes 6-8 inches long.

FRUIT—A broad, flat, thick, stubby, reddish-brown pod, 4-10 inches long, 1-2 inches broad, sometimes covered with a grayish bloom. Pods often persist far into winter and remain closed. Seeds dark brown, flat, 6-9 to a pod, over ½ of an inch across, surrounded by a somewhat sticky sweet pulp.

WOOD—Ring-porous; pores in spring wood large, in late wood small; rays distinct but not conspicuous; heavy, not hard, strong, coarse-grained, light brown to reddish-brown, durable in contact with soil; takes a fine polish. Weighs about 43 lbs. per cubic foot. Used for fence posts, fence rails, and occasionally in construction.

DISTINGUISHING CHARACTERISTICS—The Kentucky Coffee-tree, usually called Mahogany in Pennsylvania, but also known as Coffee Nut, Coffee Bean, and Nicker Tree, can readily be identified by means of its strongly marked distinguishing characteristics. The trunk is short and soon subdivides into 2-4 secondary stems which take an upright position, and are consequently almost parallel to one another. The dark gray to dark brown bark is of medium thickness and roughened by very sharp and firm projecting ridges. The reddish inner bark is often visible at the base of the bark fissures. The twigs are stout, clumsy, without spines or thorns, and greenish-brown in color but often coated with a whitish crusty film and occasionally with fine hairs. They are marked with large heart-shaped leaf-scars containing 3-5 raised bundle-scars, and contain a large and round pinkish to reddish-brown pith. The buds are all lateral, no terminal buds being present. They are small, covered with minute hairs, almost entirely imbedded in the twig, and superposed, i. e., placed above one another. The uppermost bud is usually the largest and surrounded by an incurved and hairy ring of bark. The lower buds are smaller, less evident and located within the depression on the upper margin of the lear-scar. The twigs are also marked with large orange-colored lenticels, which are especially conspicuous during the second season of their growth. The leaves are twice compound, 1-3 ft. long and up to 2 ft. broad. The ovate and entire-margined leaflets are very distinctive. They occur on lateral pinnae, except the lower pair or occasionally two pairs, which are attached to the main petiole and are about twice the size of the other leaflets. The thick, stubby, woody, and persistent fruit-pods with their large dark-brown seeds surrounded by a sweet and sticky pulp cannot be confused with those of any other native or introduced tree. The large terminal racemes or raceme-like corymbs of regular and greenish-white flowers, which appear about June are also distinctive. The Ailanthus or Tree of Heaven, introduced from China, is the only tree which bears a general resemblance to this species, and that only in the stoutness of the branches, and the large size of the leaves.

RANGE—Southern Ontario and central New York, southward to the middle of Tennessee, and westward to southern Michigan, southeastern Minnesota and Indian Territory.

DISTRIBUTION IN PENNSYLVANIA—Planted as an ornamental tree in all parts of the State. The only locality in the State where it is reported as native is along the Conococheague Creek in Franklin county. Dr. Thomas C. Porters' records show that he found it along this stream, but the writer has followed the stream from its headwaters in the South and North Mountains to the point where it empties into the Potomac without finding a single specimen. The general range of the tree indicates that it may occur in the western, particularly the northwestern part of the State, but no authentic records are available to show that it has been found there as a native tree.

HABITAT—Rich woods and bottomlands. Occurs solitary, never in clusters or pure stands. Often only a single tree known in a locality. Will grow practically anywhere in the State, if planted.

IMPORTANCE OF THE SPECIES—The Kentucky coffee-tree if of no commercial importance in this State. It is regarded attractive as an arnamental tree and is planted extensively in this State. It loses its leaves early in autumn and develops them late in spring,

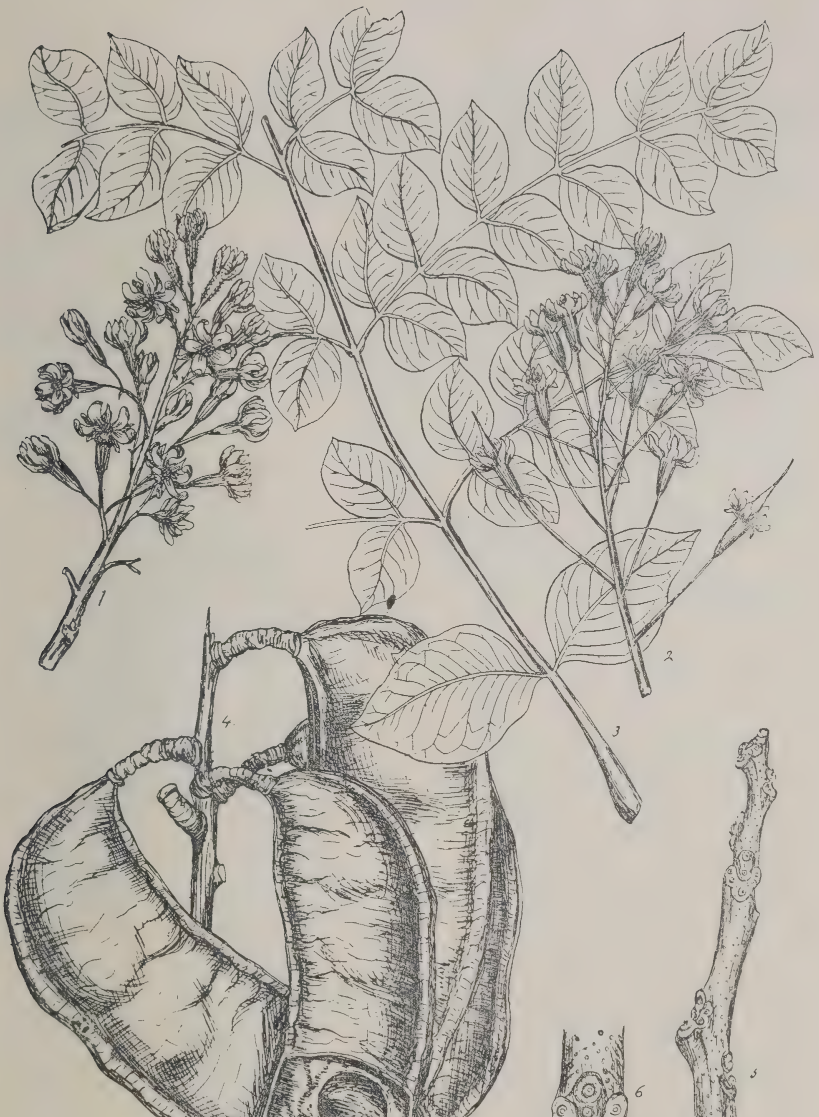

PLATE XCIV. KENTUCKY COFFEE-TREE

1. Staminate flowers, x ½.
2. Pistillate flowers, x ½.
3. Portion of a doubly compound leaf, x ½.
4. Fruit pods with a portion of one pod removed showing two seeds, x ½.
5. Section of a winter twig showing superposed and inconspicuous buds, lenticels, pith, and leaf-scars with bundle-scars, x ½.
6. Section of a winter twig, slightly enlarged.

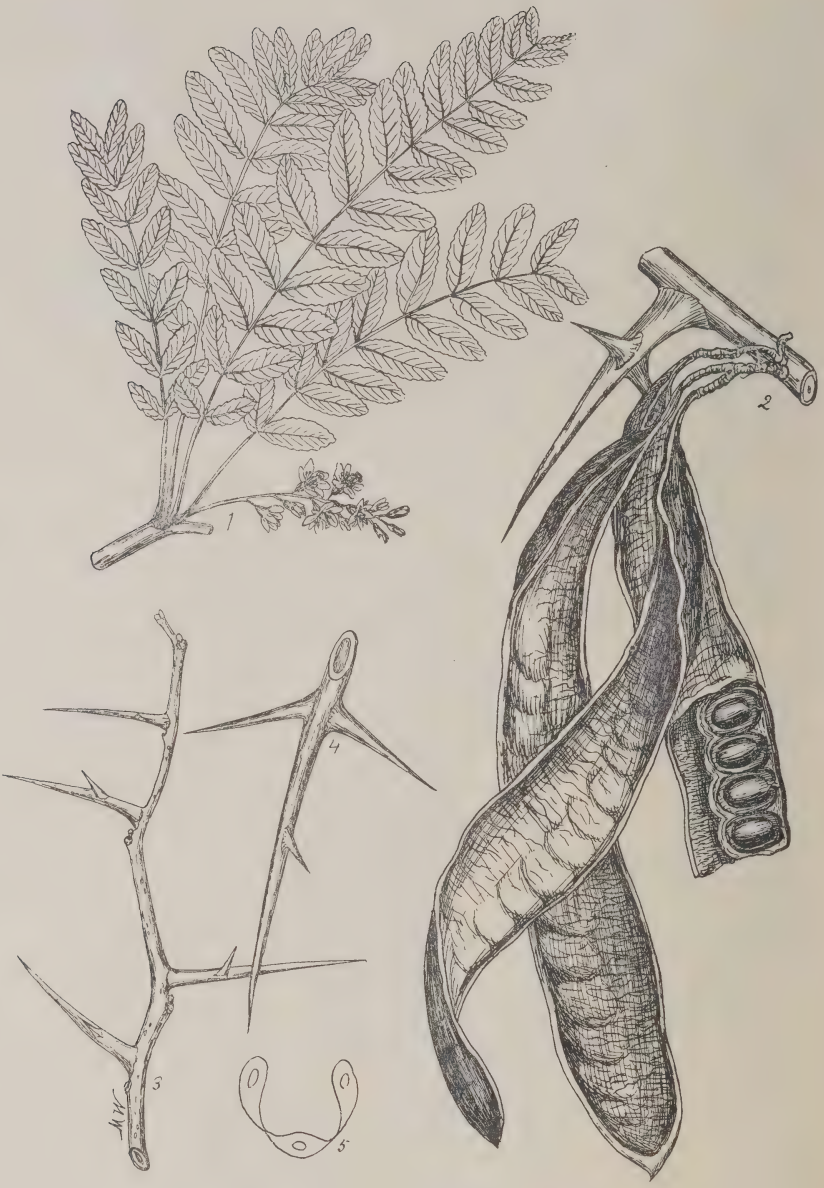

PLATE XCV. HONEY LOCUST

1. Flowering branch wtih mature leaves, x ½.
2. Section of a branch with fruiting pods and a branched thorn, x ½.
3. A winter twig with thorns, x ½.
4. A branched thorn, x ½.
5. A leaf-scar, enlarged,

HONEY LOCUST

Gleditsia triacanthos, Linnaeus

GENUS DESCRIPTION—This genus comprises about 11 species of trees which are usually armed on the branches and trunk with simple or branched thorns. They are distributed in the temperate part of Asia and eastern North America. Fossil representatives of this genus have been reported from Europe. Three species are native to eastern North America, one inhabiting Texas, one the southern and south-central United States, and one described here. The generic name is in commemoration of the German botanist, John Gottlieb Gleditsch.

FORM—A medium-sized tree usually from 40-50 ft. high with a diameter of 1-2 ft. but may reach a height of 140 ft. with a diameter of 4-6 feet. Trunk usually short but when grown in very close stands may be rather clean and long. Crown broad, obovate, round-topped, high on account of lateral drooping branches.

BARK—On young trunks smooth covered with many very conspicuous, raised, oblong lenticels; on old trunks grayish-brown to almost black, sometimes smooth but usually roughened by a few fissures and thick, firm, broad ridges with projecting edges. Bark on trunks is often covered with many thorns. See Figs. 78 and 113.

TWIGS—Rather stout, zigzag, smooth, glossy, with enlarged nodes; greenish-red to brown covered with few, small, scattered lenticels which become larger in time; pith thick and white. Twigs frequently bear thorns which are often branched and contain reddish-brown pith.

BUDS—Alternate; terminal bud absent; small, usually 3-5 at a node, placed one above another; upper ones scaly and visible, lowest one not scaly, nor visible except as a dot. Some buds are slow in developing.

LEAVES—Alternate, singly or doubly compound, 7-8 inches long. Petioles flattened, grooved above, enlarged at base. When singly compound with 18-28 leaflets; when doubly compound with 8-14 pinnae and each with usually 18-20 leaflets. Leaflets lanceolate-oblong, 1½-2 inches long, rounded at the base and apex, somewhat serrate on margins.

LEAF-SCARS—Alternate, 2-ranked or more than 2-ranked. U-shaped; varying in width; broadest about the 3 bundle-scars and narower between.

FLOWERS—Appear about May or June. Polygamous, small, greenish. Staminate flowers arranged in short hairy racemes with short stalks. Pistillate flowers in few-flowered, rather elongated and solitary racemes.

FRUIT—A more or less twisted, flat and reddish-brown pod, 10-18 inches long, containing many flat, oval, brownish seeds. The pods are thin, do not split open, often persist into winter, and occasionally are produced in large numbers.

WOOD—Ring-porous; rays conspicuous on account of their brilliancy; hard, strong, heavy, durable in contact with the soil; heartwood bright reddish-brown with thin pale sapwood. Weighs about 42 lbs. per cubic foot. Used mainly for fence posts and rails, hubs of wheels, and general construction. In time its use will be extended and it may be grown for timber.

DISTINGUISHING CHARACTERISTICS—The Honey Locust, also known as the Sweet Locust, Thorn Tree, Three-thorned Acacia, and Honey Shucks, can be distinguished by its large branched thorns located above the leaf-scars. A thornless variety is, however, known. The once-compound or sometimes twice-compound evenly-pinnate and alternate leaves together with the leathery fruit-pod from 10-18 inches long and the grayish-brown to black bark often covered with conspicuous oblong lenticels are also characteristic. A longitudinal section of a twig just above the origin of a leaf or a leaf-scar will usually show five separated and superposed buds, the upper scaly and externally visible, the lowest not scaly and hidden beneath the bark.

RANGE—Ontario through Pennsylvania to Florida, westward to Kansas and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found as a native or planted tree in all parts of the State. Its original distribution in this State was limited almost entirely to the region west of the Allegheny Mountains, except a few local outposts east of them. At present it is common as a planted tree in the entire eastern portion of the State and in many places has escaped cultivation.

HABITAT—It develops best in rich soil along moist river bottoms but will grow in any fertile soil which is not too wet. It demands plenty of light.

IMPORTANCE OF THE SPECIES—The Honey Locust is of little commercial importance as a timber tree in Pennsylvania because it is limited in its distribution. Most of the existing trees of this State are open grown and not forest grown, therefore too knotty to be of any commercial value. If properly planted it will produce excellent wood. It grows rapidly, is free from insect and fungal enemies, has an attractive form, and bears graceful foliage. The leaves come out late in spring and, hence, it is not of much value for shade.

REDBUD

Cercis canadensis, Linnaeus

GENUS DESCRIPTION—This genus comprises 7 species of small trees and shrubs found in parts of Asia, Europe, and North America. Three species are native to North America, 1 inhabiting California, 1 Mexico and Texas, and 1 eastern United States. The latter is native to Pennsylvania and described here. They are prized mainly on account of their ornamental value due to their bright rose-colored, pea-like flowers which cover the branches with a profuse and brilliant flame of color in early spring before the leaves come out.

FORM—A small tree usually about 15-20 ft. high with a diameter of 6 inches but may reach a height of 50 ft. with a diameter of 18 inches. Trunk short bearing rather upright branches which form a shallow and broad crown.

BARK—Thin, shallowly fissured separating ridges which peel off into numerous scales, reddish-brown to very dark brown. See Fig. 75.

TWIGS—Slender, smooth, light brown, becoming grayish-brown, covered with numerous very small lenticels, containing pith which sometimes has reddish longitudinal streaks.

BUDS—Alternate; terminal one absent; small, ⅛ of an inch long, blunt-pointed, dark purplish-red, spherical or somewhat flattened when appressed. Sometimes superposed with upper one usually the larger, or clustered at the base of a lateral branch, covered with 2-3 visible scales with hairy margin.

LEAVES—Alternate, simple, rounded or heart-shaped, 3-5 inches long, conspicuously 5-7 nerved, cordate at base, pointed at apex, entire on margin.

LEAF-SCARS—Alternate, 2-ranked, inversely triangular to heart-shaped, somewhat raised, containing 3 conspicuous bundle-scars. Short spreading ridges often originate at outer margin of the leaf-scars and extend down the stem for a short distance.

FLOWERS—Appear in March or April before the leaves or sometimes when the leaves are just appearing. Resemble the sweet pea in form; perfect and brilliant red, borne usually in clusters of 4-8, often developing from buds located at the base of lateral branches as well as from buds located along the branches.

FRUIT—A small, rose-colored to light brown, short-stalked pod, 2½-3 inches long, about ½ of an inch wide, containing about 6 broadly ovate, flattened, light-brown seeds. Pods may persist until early winter and are often produced in enormous quantities.

WOOD—Ring-porous; heavy, hard, not strong, rich dark reddish-brown with light sapwood. Weighs 40 lbs. per cubic foot. Not found on the market.

DISTINGUISHING CHARACTERISTICS—The Redbud, also known as the Wild Pea, and Judas Tree, can be distinguished by its simple alternate and heart-shaped leaves, its slender unarmed and light brown twigs with reddish streaked pith, its small, thin, leathery fruit-pods, and its perfect, pea-like, brilliant red blossoms which occur in clusters of 4-8, appearing in early spring before the leaves and developing from a cluster of buds located at the base of a lateral branch as well as from buds located along the twigs. This is the only tree native to this State which develops a cluster of purplish flower buds on a branch just below the origin of a lateral twig.

RANGE—Southern Ontario through New York and New Jersey to Florida, westward to Minnesota and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Not known to occur in the northern or eastern parts of the State. Reported from the southeastern, southern, central, and western parts. Common in the Schuylkill and Perkiomen Valleys and along parts of the Susquehanna River Valley, especially northwest and southeast of Harrisburg. Common about Gettysburg, and south of Chambersburg in the Cumberland Valley. Occurs in a dense pure stand covering about one acre southwest of Gettysburg.

HABITAT—Prefers rich moist soils. Common in abandoned fields, cut-over and open woodlands. Also found in the understory of the forest. Endures shade but prefers plenty of light.

IMPORTANCE OF THE SPECIES—The Redbud is of no commercial importance as a forest tree but where a tall shrub or a small tree is desired for ornamental planting hardly a more attractive one could be found. It has a pleasing form at all seasons of the year, an exceptionally beautiful and abundant bloom in spring before the leaves come out, and in addition, grows rapidly. It is cultivated extensively in Europe as an ornamental tree.

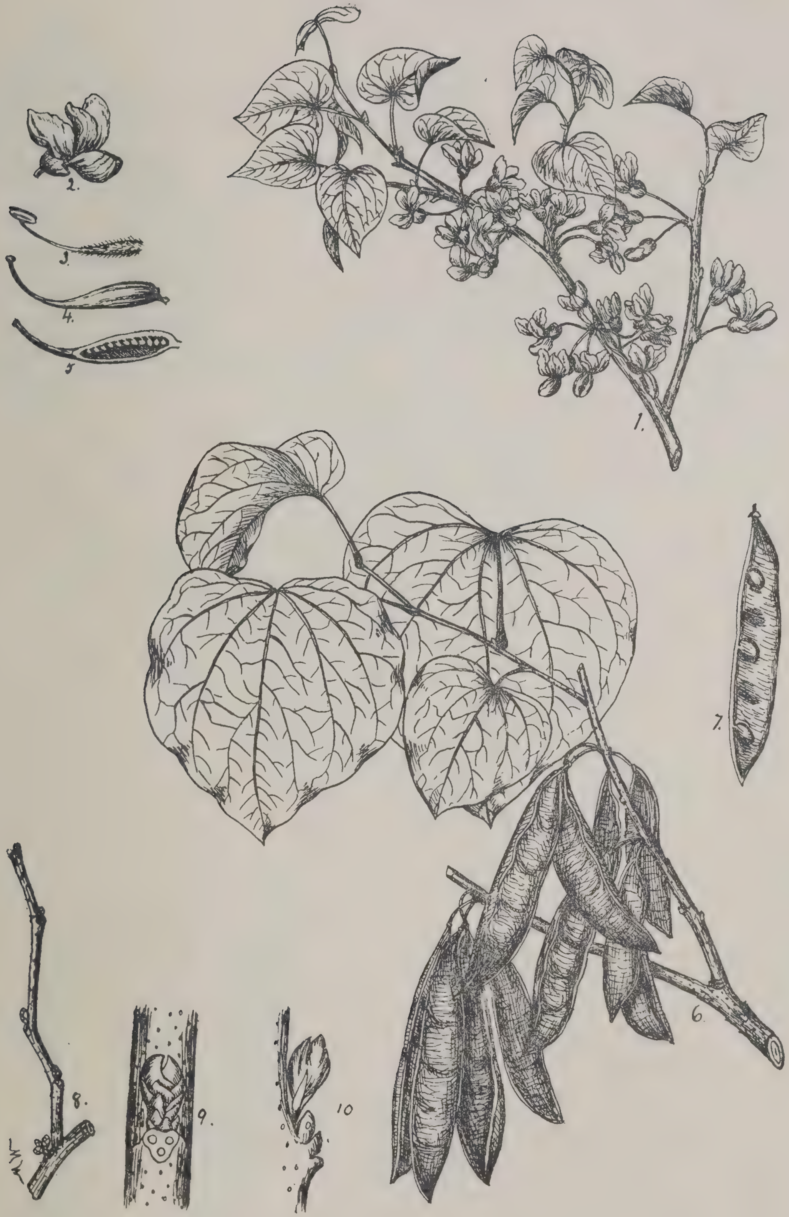

PLATE XCVI. REDBUD

1. A flowering branch, x ½.
2. A single flower, x ½.
3. A single stamen, enlarged.
4. A single pistil, enlarged.
5. A pistil with ovary sectioned so as to show the ovules, enlarged.
6. A fruiting branch, x ½.
7. An opened pod showing the seeds, x ½.
8. A winter twig, x ½.
9. Section of the winter twig, enlarged.
10. Portion of a winter twig showing location and arrangement of buds, enlarged.

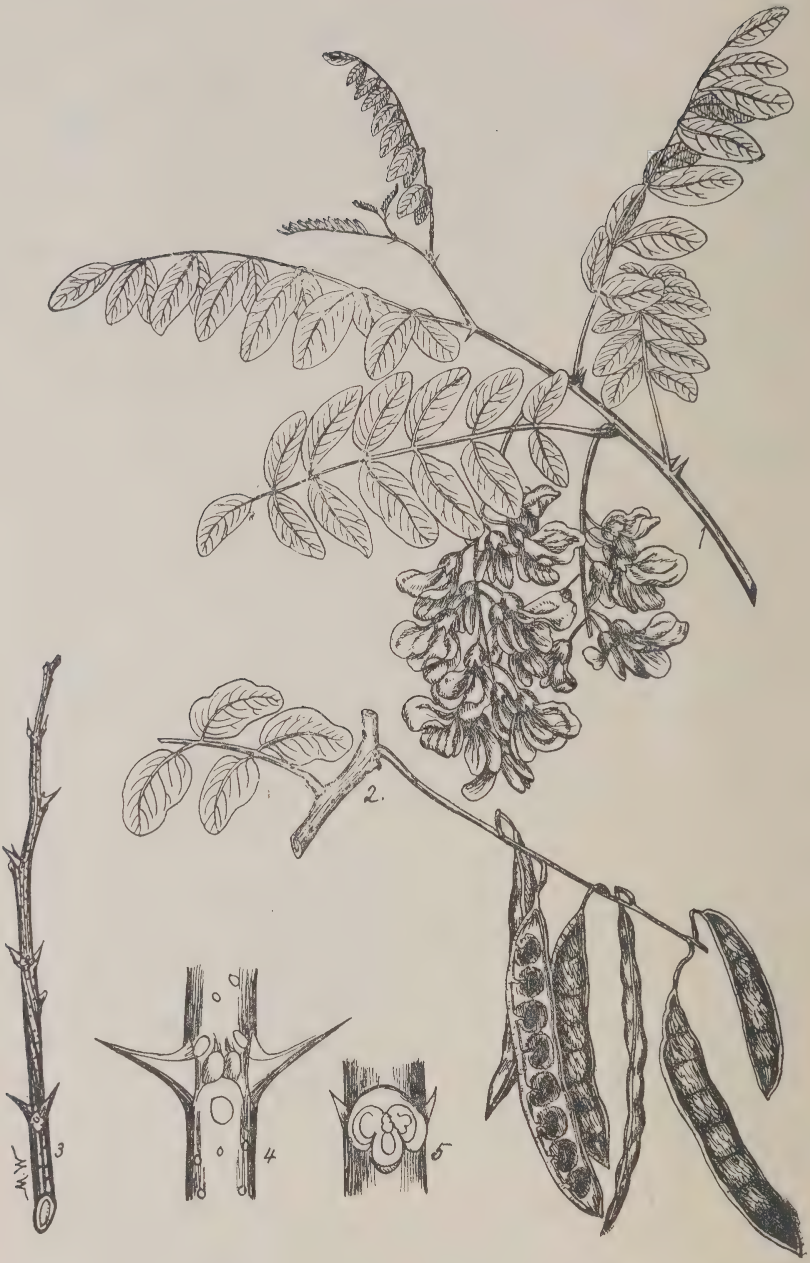

PLATE XCVII. COMMON LOCUST

1. A flowering branch, x ½.
2. A fruiting branch, x ½.
3. A winter twig, x ½.
4. Section of a winter twig, enlarged.
5. Section of a winter twig, enlarged.

COMMON LOCUST

Robinia Pseudo-Acacia, Linnaeus

GENUS DESCRIPTION—This genus comprises 7 species of trees and shrubs native only to North America but some are planted extensively in Europe. Three of the 7 species reach tree-size while the others remain shrubs. The generic name is in commemoration of the French botanist Jean Robin and his son Vespasien.

FORM—A medium-sized tree usually 30-45 ft. high with a diameter of 1-1½ ft. but may reach a height of 75 ft. with a diameter of 2-2½ feet. Forest-grown specimens are often straight, clean, and free from branches for ¾ of height of tree. Open grown specimens usually branch low. Crown usually narrow, oblong, and open.

BARK—On both young and old trunks rough, reddish-brown, deeply furrowed, with high rather rounded ridges which do not peel off in scales; sometimes 1-1½ inches in thickness. See Fig. 102.

TWIGS—Rather stout, brittle, more or less zigzag, round to angular in cross-section, sometimes ridged, greenish to reddish-brown; often bearing two spines at a node, covered with a few pale lenticels; pith white and often angular.

BUDS—Alternate; terminal one absent; small, 3-4 superposed, imbedded in twig under leaf-scar in a rusty somewhat hairy cavity. Their position is hardly visible in winter but becomes evident in spring when growth starts.

LEAVES—Alternate, compound, 8-14 inches long; petioles slender, grooved on top, and swollen at the base. Leaflets odd in number and stalked, ovate to oblong, 7-21 in number, 1-2 inches long, usually rounded at apex and base, entire on margin.

LEAF-SCARS—Alternate, more than 2-ranked, rather large and conspicuous, irregular in outline, covering the buds; often located between two prickles which are developed and hardened stipules; contain 3 bundle-scars.

FLOWERS—Appear about May after the leaves or occasionally before the leaves, resembling the blossom of a pea. Perfect, cream-white, about an inch across, fragrant, borne on slender stalks about ½ of an inch long, arranged in loose drooping racemes 4-5 inches long.

FRUIT—A small, dark brown, and thin pod, 2-4 inches long and ½ of an inch wide; usually containing from 4-8 small dark brown mottled seeds. The pods often persist far into winter.

WOOD—Ring-porous; rays quite distinct, especially on radial section; heavy, very hard and strong, very durable in contact with the soil, yellowish-brown to cherry-red or reddish-brown with thin greenish or yellowish sapwood. Weighs about 46 lbs. per cubic foot. Used extensively in former time for ship building, and at present for posts, in turnery, for tree nails, insulator pins, and fuel.

DISTINGUISHING CHARACTERISTICS—The Common Locust, also known as the Black Locust, Yellow Locust, White Locust, Locust, and Acacia, may be distinguished by its drooping racemes of white irregular flowers, its odd-pinnate compound leaves, its twigs with two short spines at a node, its 2-4 inch long leathery fruit pod and its deeply furrowed reddish-brown bark. The leaf-scars located between the two spines when present and covering 3-4 rusty downy superposed buds are also characteristic. The disagreeable odor and yellow color of the roots are distinctive. The characteristic coloration of the foliage of this tree when attacked by the Locust Leaf Miner and the characteristic swelling of the branches when attacked by the Locust Borer aid in recognizing it. The presence of the fruiting body of the Locust Rot (Fomes rimosus) so common in southern Pennsylvania, is a sure means of identifying the tree.

RANGE—Mountains of Pennsylvania, south to Georgia, westward to Iowa and Kansas. Naturalized over an extensive area in America and widely planted in Europe.

DISTRIBUTION IN PENNSYLVANIA—Originally it was found only in the central and southern portions of the Allegheny Mountains in this State. At present it is found all over the State as an ornamental tree or in fence rows and in many places it has escaped into the forest and abandoned fields.

HABITAT—Grows vigorously, on moist fertile soil, especially on rich bottomlands and along mountain streams. Also grows on rather rocky and sterile mountain slopes. Frequent on abandoned charcoal hearths and mud-dams found near ore mines.

IMPORTANCE OF THE SPECIES—The real importance of the Common Locust is somewhat in doubt. It produces excellent wood and grows rapidly in some localities, especially where it is free from enemies. Two insects, known as Locust Borer and Locust Leaf Miner, and a fungus known as the Locust Rot (Fomes rimosus), are doing enormous damage to this tree locally. In regions where these enemies are wanting and where suitable soil and climate are at hand it may be advisable to plant this tree especially when posts, poles, or ties are desired. A large quantity of wood is being profitably disposed of on the Bedford State Forest, near Rainsburg, Bedford county, for the manufacture of insulator pins. During the World War there was an unusual demand for this wood for the purpose of manufacturing tree nails used in ship-building. It has very attractive flowers which may appear before, with, or after the leaves.

THE CASHEW FAMILY—ANACARDIACEAE

This family contains a large number of small trees and shrubs and a few woody climbers widely distributed over the world, but most abundant in the tropics. Many of the representatives of this family are noted for their acrid, resinous, or milky juice which makes them of considerable value in medicine, tanning, and the manufacture of varnishes and resins.

About 50 genera with 500 species belong to this family. North America has few representatives. Only 3 genera with tree representatives are embraced in its flora. The genus Rhus is the only one native to northeastern America. It has six representatives in Pennsylvania.

THE SUMACHS—RHUS, Linnaeus

The Sumachs comprise a large number of trees and shrubs which are widely distributed. About 120 species are known of which number about 16 are native to North America and 6 to Pennsylvania. Most of the members of this genus are found in South Africa. All have large pithy twigs and a milky, sometimes poisonous, sticky juice. The leaves of all are alternate. One species alone is evergreen and one other has simple leaves. All others are deciduous and have compound leaves.

Three of the 6 species native to Pennsylvania reach tree-size. The others are mere shrubs. The Poison Ivy or Posion Oak (Rhus Toxicodendron L.) is very abundant along fences and by roadsides. Its stem often trails along the ground and sends up short branchlets which bear the compound leaves with 3 leaflets. The leaves are poisonous to the touch. The Smooth Sumach (Rhus glabra L.) is a low-growing and spreading shrub sometimes becoming a small tree. It has glabrous branchlets which are more or less glaucous. It has compound leaves with 11-31 leaflets. It is very common in abandoned fields and seems to thrive on sandy soil. The Fragrant Sumach (Rhus canadensis Marsh.) reaches a height of 2-6 ft. It has compound leaves with 3 leaflets which are aromatic when crushed. The Smoke-Tree (Rhus Cotinus L.) is one of the commonest plants of our gardens and lawns. It is an introduced species coming from Europe and warm-temperate Asia. Locally it has escaped cultivation.

SUMMER KEY TO THE SUMACHS

Page

1. Leaf-petioles winged; leaflets with entire margins except near apex, ... R. copallina 192
1. Leaf-petioles not winged; leaflets either with entire or serrate margins, ... 2

2. Leaflets 7-13, with entire margins, ... R. Vernix 190
2. Leaflets 11-31, with serrate margins, ... 3

3. Leaflets glaucous beneath; twigs smooth; shrubs, ... R. glabra 188
3. Leaflets not glaucous beneath; twigs densely hairy; small trees, ... R. typhina 191

WINTER KEY TO THE SUMACHS

1. Terminal bud present; fruit white, smooth, in loose, drooping, grape-like clusters, frequents swamps; leaf-scars broad, do not encircle buds; juice poisonous, R. Vernix 190
1. Terminal bud absent; fruit red; hairy, in compact erect clusters; frequents dry soils; leaf-scars encircle or almost encircle buds; juice not poisonous, ... 2

2. Twigs stout, with watery juice; leaf-scars broadly crescent-shaped, ... R. copallina 192
2. Twigs very stout, with milky juice; leaf-scars narrower, ... 3

3. Twigs densely hairy, ... R. typhina 191
3. Twigs smooth, ... R. glabra 188

POISON SUMACH

Rhus Vernix, Linnaeus

FORM—A shrub or small tree, usually 5-10 ft. high but may reach a height of 20 ft. with a diameter of 8 inches. Usually branches near ground. Crown wide, deep, and usually rounded.

BARK—Smooth, somewhat streaked, thin, light to dark gray, roughened with horizontally-elongated lenticels.

TWIGS—Stout, orange-brown, later light gray, smooth, often glossy, covered with numerous raised lenticels, contain yellowish-brown pith; if punctured or cut, exude watery juice which turns yellow upon exposure.

BUDS—Alternate; terminal bud present and larger than lateral ones; purplish, conical, acute, about 1/5-3/5 of an inch long, covered with a few scales which are downy on back and margin.

LEAVES—Alternate, compound, 7-14 inches long, with wingless petiole, and with 7-13 leaflets, obovate, 3-4 inches long, acute at apex, wedge-shaped at base, entire-margined, dark green and shiny above, pale below.

LEAF-SCARS—Alternate, large, broad, conspicuous, do not encircle buds, upper margin straight or nearly so, contain numerous bundle-scars which are scattered or arranged in a curved line.

FLOWERS—Appear about June or July. Staminate and pistillate flowers borne on different plants. The small yellowish-green flowers are arranged in long, drooping, rather narrow panicles.

FRUIT—A small spherical, glossy, ivory-white to yellowish-white drupe arranged in loose, drooping, grape-like clusters. It is about 1/5 of an inch in diameter, slightly compressed and often persists far into winter. Ripens about September. Pistillate trees alone bear fruit.

WOOD—Ring-porous; brittle, soft, coarse-grained, light yellow in color. Weighs 27 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Poison Sumach, also known as Poison Oak, Poison Dogwood, Poison Elder, and Swamp Sumach, can be recognized in winter by its alternate buds with the terminal bud present, its broad leaf-scars which do not encircle the bud and its smooth and rather stout branchlets. The white berry-like fruit arranged in drooping clusters often persists far into winter. The leaves are compound, without winged petioles and have from 7-13 shiny leaflets with entire margin which turn to a brilliant scarlet or orange in autumn. This species is usually found in swamps.

RANGE—Ontario, south to Florida, west to Minnesota and Louisiana.

DISTRIBUTION IN PENNSYLVANIA—Occasional and local in the eastern, southern, and central parts. Rarer in other parts. Numerous large specimens occur in the swamps of the South Mountains in Adams and Franklin counties.

HABITAT—Prefers low grounds and swamps. Occasionally found on moist slopes.

IMPORTANCE OF THE SPECIES—The Poison Sumach is one of our most poisonous plants. The wood which it produces is of no commercial importance. Some people are entirely immune to its poisonous principles, while others are affected by simply handling it, while a few need only to walk by it. It is claimed all traces of the poison can be removed by washing the parts thoroughly with a saturated alcoholic solution of acetate of lead immediately or within a few hours after the contact. Pure alcohol is also valuable as a wash if applied shortly after contact.

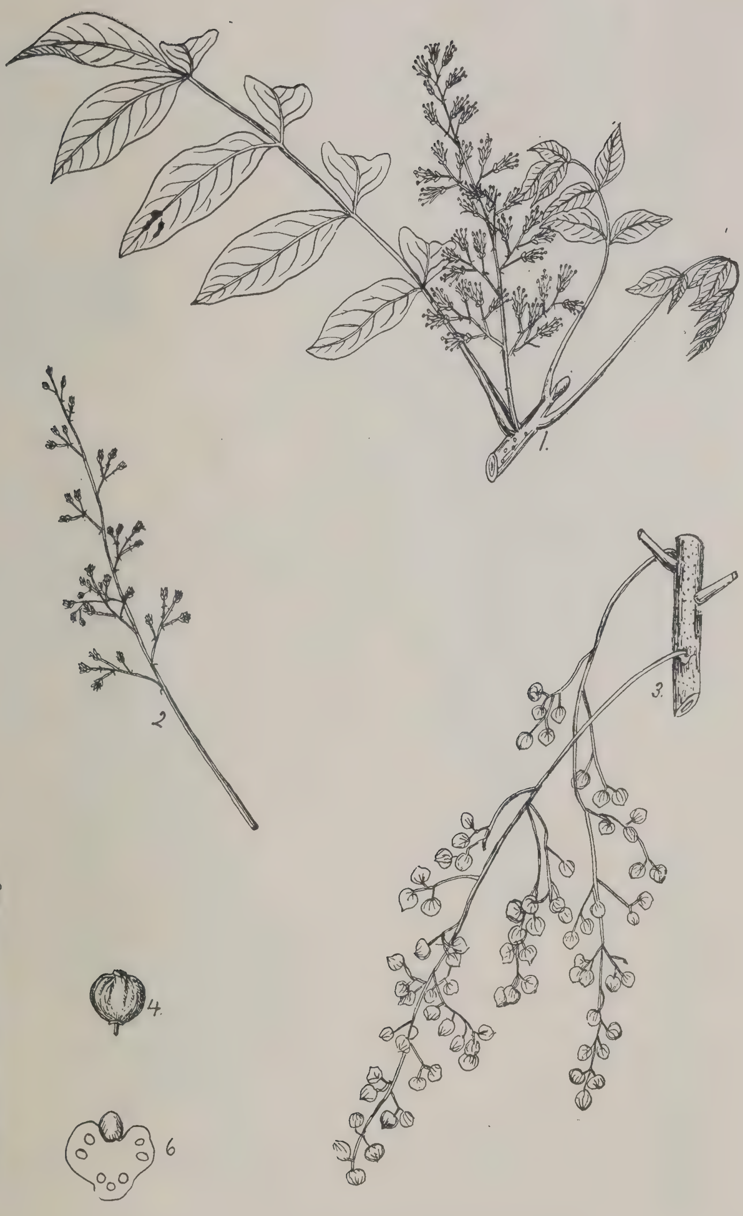

PLATE XCVIII. POISON SUMACH

1. Branch with immature and mature leaves, and a staminate flower panicle, x ½.
2. A pistillate flower panicle, x ½.
3. A section of a branch with two drooping clusters of fruit, x ½.
4. A single fruit enlarged.
5. A winter twig, x ½.
6. An axillary bud and a leaf-scar with bundle-scars, enlarged.

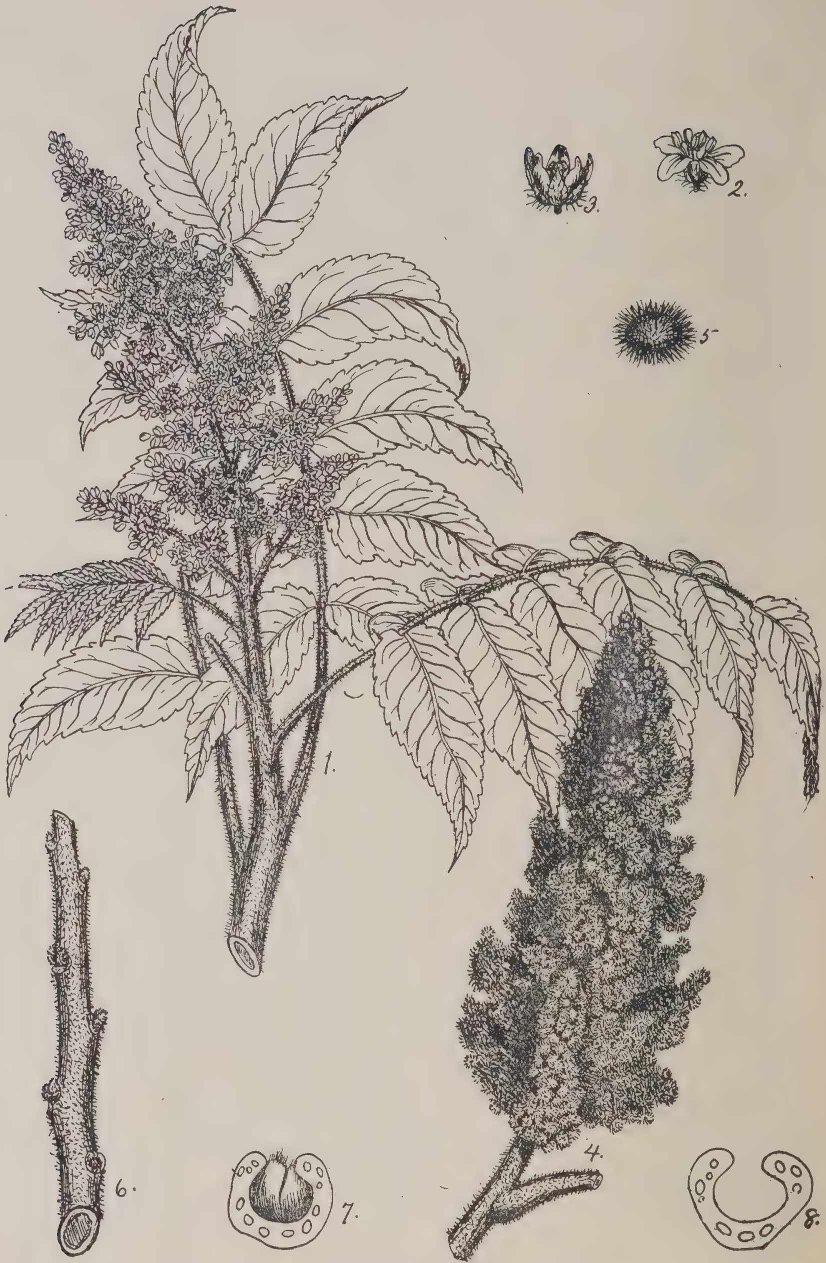

PLATE XCIX. STAGHORN SUMACH

1. Branch with a flower panicle and mature leaves, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. An erect cone-like fruit cluster, x ½.
5. A single hairy fruit, enlarged.
6. A hairy winter twig, x ½.
7. A bud almost surrounded by a leaf-scar with bundle-scars, enlarged.
8. A leaf-scar, enlarged.

STAGHORN SUMACH

Rhus typhina, Linnaeus

FORM—A shrub or small tree usually reaching a height of 10-20 ft. but may reach a height of 40 ft. with a diameter of 15 inches. Trunk usually short, bearing a broad flat-topped crown. Lateral branches are decidedly ascending.

BARK—On old trunks rough, dark brown, sometimes scaly; on younger trunks and branches smooth, thin, somewhat papery, covered with numerous lenticels which later develop into rough dots. Rich in tannin.

TWIGS—Covered for 3 years with brown to black velvety pubescence, later smooth, stout, clumsy; if cut or punctured exude a milky juice, which turns black upon exposure. Twigs are often frozen back in winter. They are covered with conspicuous orange-colored lenticels, and contain a large yellowish-brown pith.

BUDS—Alternate; terminal bud absent; conical, spherical obtuse, covered with dense rusty hairs.

LEAVES—Alternate, compound, 16-24 inches long, with stout wingless petiole and 11-31 leaflets. Leaflets oblong, 2-5 inches long, nearly sessile; acute at apex, serrate on margin, rounded or heart-shaped at base; when mature smooth, dark green above, and pale beneath.

LEAF-SCARS—Alternate, nearly encircle bud, large, conspicuous, U-shaped, contain scattered bundle-scars sometimes grouped in 3s.

FLOWERS—Appear in May or June. Occur in dense yellowish-green panicles. Staminate panicles are about 8-12 inches long and 5-6 inches broad. Pistillate panicles are only 5-8 inches long but more compact.

FRUIT—Arranged in compact, erect, cone-like, red clusters which are 5-8 inches long, 2-3 inches broad and persist far into winter. Only plants bearing pistillate flowers produce fruit. The single fruit is a spherical drupe covered with red hairs and contains a small hard seed. Sumachs with red fruit are not poisonous.

WOOD—Ring-porous; brittle, soft, orange-colored, streaked with green, rather satiny to touch. Sapwood broad and white. Weighs 27 lbs. per cubic foot. Used for manufacture of spiles, cups, napkin rings, and balls for darning stockings.

DISTINGUISHING CHARACTERISTICS—The Staghorn Sumach, also known as Velvet Sumach, can be distinguished from all our native Sumachs by its velvety pubescent twigs. The Smooth Sumach (**Rhus glabra L.**) is usually smaller and has its twig covered with a bloom, but not with pubescence. The Dwarf Sumach (**Rhus copallina**) has winged petioles and a watery juice while the Staghorn Sumach has no winged leaf-petioles but has a milky juice. The Poison Sumach has a terminal bud, white drooping fruit, entire leaf-margins, leaf-scars which do not encircle buds, and frequents swamps, while the Staghorn Sumach has no terminal bud, has red and erect fruit clusters, serrate leaf-margins, leaf-scars which almost encircle buds, and frequents dry soils.

RANGE—New Brunswick to Minnesota, and southward to Georgia and Alabama.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State. Very common in eastern and southern parts. Rarer in northern and western parts.

HABITAT—Usually found on fertile dry upland soil. Rarer on border of swamps and streams. Frequents abandoned fields and fences.

IMPORTANCE OF THE SPECIES—The Staghorn Sumach is of little commercial importance. The wood is rarely used. The bark of the stem and roots, and the leaves are rich in tannin. It is occasionally planted for ornamental purposes.

DWARF SUMACH

Rhus copallina, Linnaeus

FORM—A small shrub rarely more than 6-8 ft. tall, becomes a tree only in Arkansas and Texas.

BARK—Rather thin, light to reddish-brown, often smooth; on older specimens may peel off into papery layers, frequently roughened by large, elevated, brownish projections.

TWIGS—At first hairy, somewhat zigzag and greenish-red; later smooth, reddish-brwon, and roughened by prominent leaf-scars and large dark-colored lenticels; frequently roughened by large elevated rugosities.

BUDS—Alternate; terminal bud absent; axillary, small, spherical, covered with rusty brown pubescence.

LEAVES—Alternate, compound, 6-12 inches long, with winged petioles and 9-21 leaflets. Leaflets ovate-lanceolate, acute at apex, often unequal and wedge-shaped at base, entire on margin except near apex where a few serrate teeth may be found, usually smooth above and pubescent below.

LEAF-SCARS—Alternate, broadly crescent-shaped to inversely triangular; partly surround buds; contain a few clusters of bundle-scars often occurring in 3s.

FLOWERS—Appear about July. Produced in axillary or terminal panicles. Staminate and pistillate usually occur on different plants.

FRUIT—Matures about 5-6 weeks after flowers. Usually arranged in dense, stout, pubescent, often persistent, red clusters. The individual fruit is spherical, about ⅛ of an inch across, covered with a hairy red coat and contains a smooth orange-colored seed.

WOOD—Diffuse-porous; soft, coarse-grained, light brown, richly striped with yellow and black. Weight and uses are about the same as the Staghorn Sumach.

DISTINGUISHING CHARACTERISTICS—The Dwarf Sumach, also known as Mountain Sumach can be distinguished from our other native species of Sumach by its winged leaf-petioles and its leaflets which are entire-margined except near the apex. Its branches contain a watery juice while the branches of the Staghorn and Smooth Sumach contain a milky juice. Its branches are roughened by conspicuous raised lenticels while those of the Smooth Sumach are covered with a bloom and those of the Staghorn Sumach with a velvety pubescence. It has neither terminal buds nor white fruit like the Poison Sumach.

RANGE—Maine to Florida, west to Nebraska and Texas.

DISTRIBUTION IN PENNSYLVANIA—Local, often common, throughout the State.

HABITAT—Common on dry hillsides and ridges. Occasional on rich bottomlands. Frequents abandoned fields.

IMPORTANCE OF THE SPECIES—The Dwarf Sumach is merely a shrub east of the Mississippi and consequently of no commercial importance. It may be utilized in landscape gardening on account of its dwarf form and attractive autumnal foliage. It reaches tree-size in Arkansas and Texas.

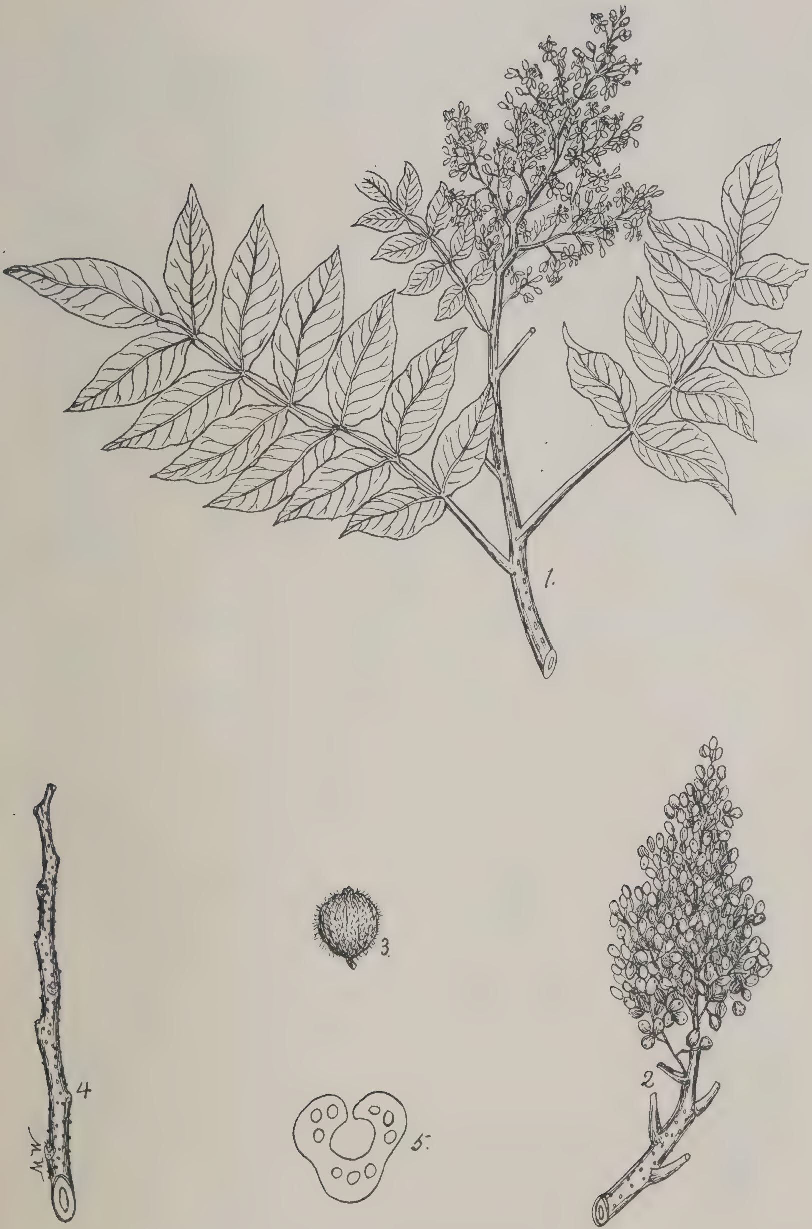

PLATE C. DWARF SUMACH

1. Branch with mature leaves with winged rachises, and a panicle of flowers, x ½.
2. A branch with an erect cluster of fruit, x ½.
3. A single hairy fruit, enlarged.
4. A winter twig, x ½.
5. A leaf-scar with bundle-scars, enlarged.

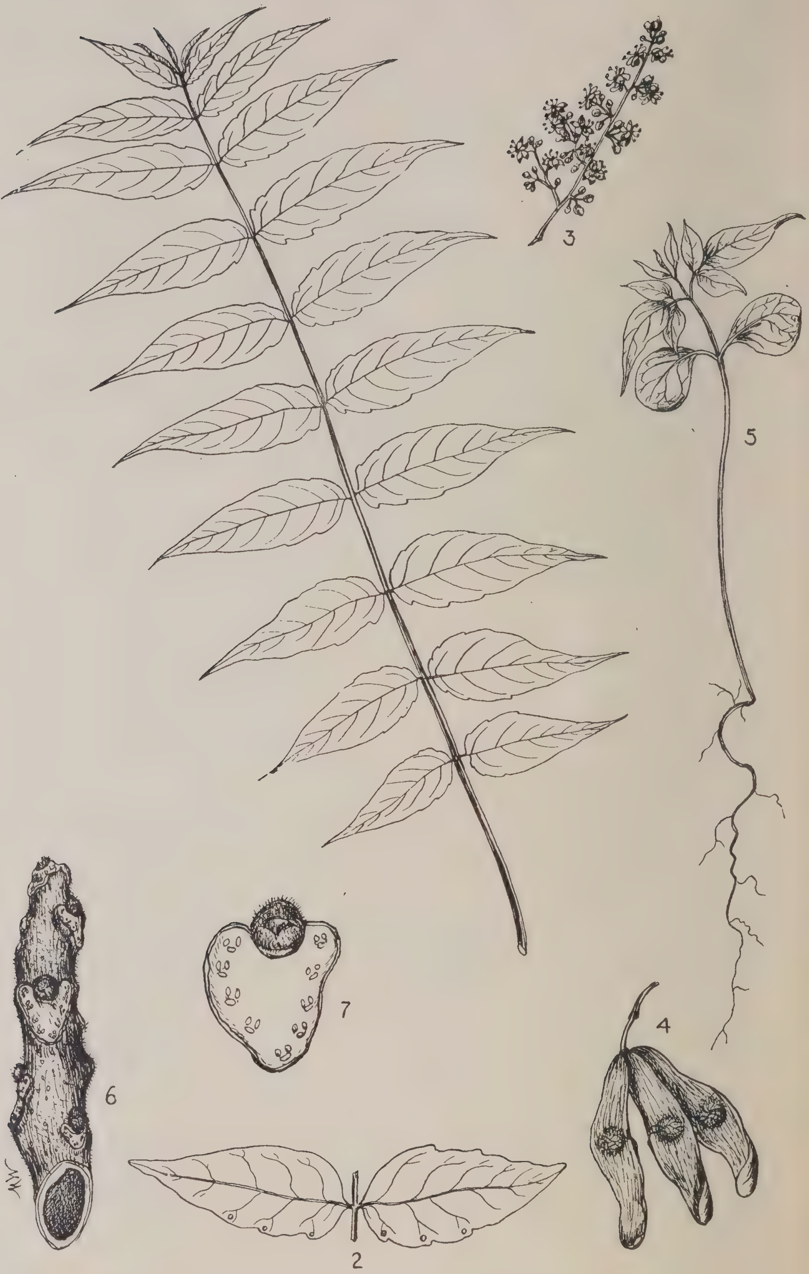

PLATE CI. TREE OF HEAVEN

1. A mature leaf, x ½.
2. Lower side of two leaflets showing glands, x ½.
3. A panicle of flowers, x ½.
4. A small cluster of winged seeds, x ½.
5. A seedling, x ½.
6. A winter twig, x ½.
7. A bud and a leaf-scar with bundle-scars, natural size.

TREE OF HEAVEN

Ailanthus glandulosa, Desfontaines

FAMILY AND GENUS DESCRIPTION—The Quassia family, Simarubaceae, comprises about 30 genera with 150 species found mostly in the tropics and the warmer parts of both the eastern and western hemispheres. Three genera, each with 1 tree species, are native to the southern part of the United States. A single species of a fourth genus has been introduced from China. This genus, Ailanthus, contains 7 species all native to eastern Asia. No member of this family is native to Pennsylvania.

FORM—May reach a height of 100 ft. with a diameter of 3 ft., but usually much smaller. Trunk usually short, but sometimes long, bearing stout branches with few branchlets. Crown wide, high, and flat-topped.

BARK—On youngr trunks smooth, thin, light gray sometimes roughened with fissures. Ridges usually dark and stand in strong contrast with the light fissures. On old trunks thin, close, roughened with diamond-shaped fissures, dark gray and sometimes black. See Fig. 118.

TWIGS—Stout, clumsy, yellowish-green to reddish-brown, covered with a fine velvety down, and numerous, longitudinally-elongated, ochre-colored, scattered lenticels. Pith large, rather hard, light brown. When broken or crushed the twigs give forth a rank smell. Longitudinal striations may appear after outer covering of twigs scales off.

BUDS—Alternate; terminal bud absent; false terminal bud often present; reddish-brown, downy, about 1/8-1/6 of an inch long, located in notch of upper surface of the leaf-scar, covered with scales; the two outer scales do not quite cover the bud, hence they have a narrow slit running parallel with the twig.

LEAVES—Alternate, compound, 1½-3 ft. long, composed of 11-41 leaflets. Leaflets ovate-lanceolate, 3-5 inches long, acuminate at apex, truncate to heart-shaped at base, almost entire with a few coarse teeth towards the base of the leaf. Glands may be present on the lower side of the leaflets near or on the small basal lobes.

LEAF-SCARS—Alternate, large, conspicuous, more than 2-ranked, heart-shaped, lighter in color than twig, have raised margins and contain about 8-14 conspicuous bundle-scars arranged in a V-shaped line. Bundle-scars sometimes curved or compounded.

FLOWERS—Appear about June when leaves are fully developed. Staminate and pistillate flowers occur on separate trees. Individual flowers small, green, and arranged in terminal panicles. The staminate has a very unpleasant odor.

FRUIT—Borne only on female or pistillate trees in conspicuous clusters which often persist far into winter. Each fruit consists of a spirally twisted wing about 1½ inches long and ½ of an inch wide, in the center of which a small seed is located.

WOOD—Ring-porous; with conspicuous rays; white to pale yellow, light, soft, weak, and open-grained. Used in cabinet work, for wooden ware, and for charcoal.

DISTINGUISHING CHARACTERISTICS—The Tree of Heaven, also known as Paradise Tree, Ailanthus, Haven-Wood and Chinese Sumach, can be distinguished in winter by its stout twigs which are covered with fine down and conspicuous scattered lenticels, and contain a large light brown pith; twigs are roughened by large heart-shaped leaf-scars containing a curved line of bundle-scars. The small gaping downy buds situated in the notch on the upper surface of the leaf-scars, are also characteristic. In summer the large alternate leaves with 11-41 leaflets which often have glands on the lower surface, are distinctive. The bark cannot be confused with that of any native tree.

RANGE—Native of China. Widely planted in Ontario, Canada and the northeastern United States. Frequently it has escaped cultivation and is found in abandoned fields, in forest borders, and along fences.

DISTRIBUTION IN PENNSYLVANIA—Naturalized extensively in the eastern, southern, central, and western parts of the State. Escaped cultivation in many places. Thickets of it are found in Franklin county. In some places it is not only found in the open fields and along fences but is migrating into the forest with the hardwoods and pines.

HABITAT—Tolerates almost any kind of soil and dense shade. Its rapid growth often enables it to dominate its associates.

IMPORTANCE OF THE SPECIES—The Tree of Heaven is of no special importance as a forest tree and has serious demerits as a shade or park tree. It was introduced into England about 1751 by missionaries and from there it was soon brought to America and first planted near Philadelphia. At first it was a very popular tree, but it soon lost favor. The staminate flowers are very ill smelling. The rapid and free growth of the root sprouts makes it almost impossible to eradicate it when once established. Its aggressive migration into fields and forests is undesirable.

AMERICAN HOLLY

Ilex opaca, Aiton

FAMILY AND GENUS DESCRIPTION—The Holly family, Aquifoliaceae, comprises 3 genera with about 290 species of small trees and shrubs distributed in temperate and tropical regions. Two genera, Ilex and Nemopanthus, are native to Pennsylvania. The former genus is represented by 5 species and the latter by 1 species. Two of the 5 species of the genus Ilex are described below. The Mountain Holly, Nemopanthus mucronata, is usually a shrub rarely over 10 ft. in height.

FORM—Usually a small tree reaching a height of 15-30 ft., but may attain a height of 50 ft. with a diameter of 3 feet. It is small in the North, but becomes larger in the South. Trunk short and bears slender, spreading and ascending branches which form a conic crown.

BARK—Close, white or grayish-brown, or yellowish-brown, up to ½ of an inch in thickness, becoming rough with age.

TWIGS—Rather slender, finely rusty hairy but soon becomes smooth and light brown, covered by a few inconspicuous lenticels.

BUDS—Alternate; terminal one present and pointed; lateral ones are short, blunt-pointed and somewhat downy.

LEAVES—Alternate, simple, evergreen, thick, mostly smooth, flat, oval, with wavy margin and spiny teeth. Petioles are short, stout, and often hardy. Midrib is very prominent on the lower surface of the leaf.

LEAF-SCARS—Alternate, semi-oval, rather conspicuous, with raised margin containing solitary bundle-scars.

FLOWERS—Appear from April to June. The staminate and pistillate usually occur on different trees. The staminate are 2-9 on a common stalk while the pistillate are usually solitary.

FRUIT—A bright red drupe, about the size of a pea, smooth, shining, persisting far into winter; containing a light brown nutlet with usually 4 ribs.

WOOD—Diffuse-porous; with distinct and colorless medullary rays; chalky-white in color, medium in weight, hard, tough, not strong, close-grained. Weighs 36 lbs. per cubic foot. Used in turnery, cabinet making and interior finishing, and for keys in pianos and organs.

DISTINGUISHING CHARACTERISTICS—The American Holly, also known as Holly or White Holly, can be distinguished at any season of the year by its unique leaves, which are thick, flat, and oval, have wavy margins with scattered spiny teeth and persist for 2 or more years. Branches, bearing these unique leaves, are sold extensively about Christmas in most of our northern markets. The small red fruit, often persisting far into winter, is also distinctive. In cultivation one often finds the closely related European Holly (Ilex Aquifolium) which has leaves of a deeper green and with more wavy margins which have translucent edges. The berries of the European species are deeper red in color.

RANGE—Maine, through Pennsylvania to Florida, westward to Indiana, Missouri, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found only in the southern and southeastern parts of the State, and a few additional isolated outposts. Occurs in the following counties: Berks, Bucks, Dauphin, Delaware, Clinton, Chester, Franklin, Fulton, Lancaster, Montgomery, and York. Probably most abundant along the Susquehanna River between McCall's Ferry and the Mason and Dixon line, and in the southern portion of Lancaster county. Dr. H. Justin Roddy, Millersville, Pa., states that "the tree is quite abundant below McCall's Ferry, Lancaster county. About every twentieth tree on the islands and banks is an American Holly. Formerly many large trees occurred there, some reaching a height of 50 ft. and a diameter of 12 inches or more. When these large trees bloomed they filled the whole canyon-like valley for miles with perfume," Prof. S. S. Simons, Marietta, Pa., writes that "the American Holly is common on what is locally known as 'Holly Island' in the Susquehanna River at Holtwood. On the mainland of Lancaster county it can be found along the 'River Hills' from Holtwood to Maryland. In Dunmore township it occurs in sufficient quantities to be used for decorative purposes. During the Christmas season of 1916 I saw a wreath over 50 feet long in a rural school made from American Holly gathered locally." In some of the other counties it is very rare. Only one wild specimen is known in Franklin county, and only a few in Berks, Bucks, Dauphin, and Montgomery counties. It is also reported from Fayette, Lebanon, and Somerset counties. One specimen was found in Clinton county in 1921, and in 1923 a single specimen was found near Black Run school house in Buffalo Township in Union county.

HABITAT—Usually found in moist soil near water. Prefers sheltered and shaded situations.

IMPORTANCE OF THE SPECIES—The American Holly does not produce any wood of commercial importance in this State. Immense quantities of branches, bearing the unique and attractive leaves and bright red berries, are used for decorative purposes during the Christmas season. It is occasionally planted for ornamental purposes because it is very beautiful, but one should remember that it grows slowly.

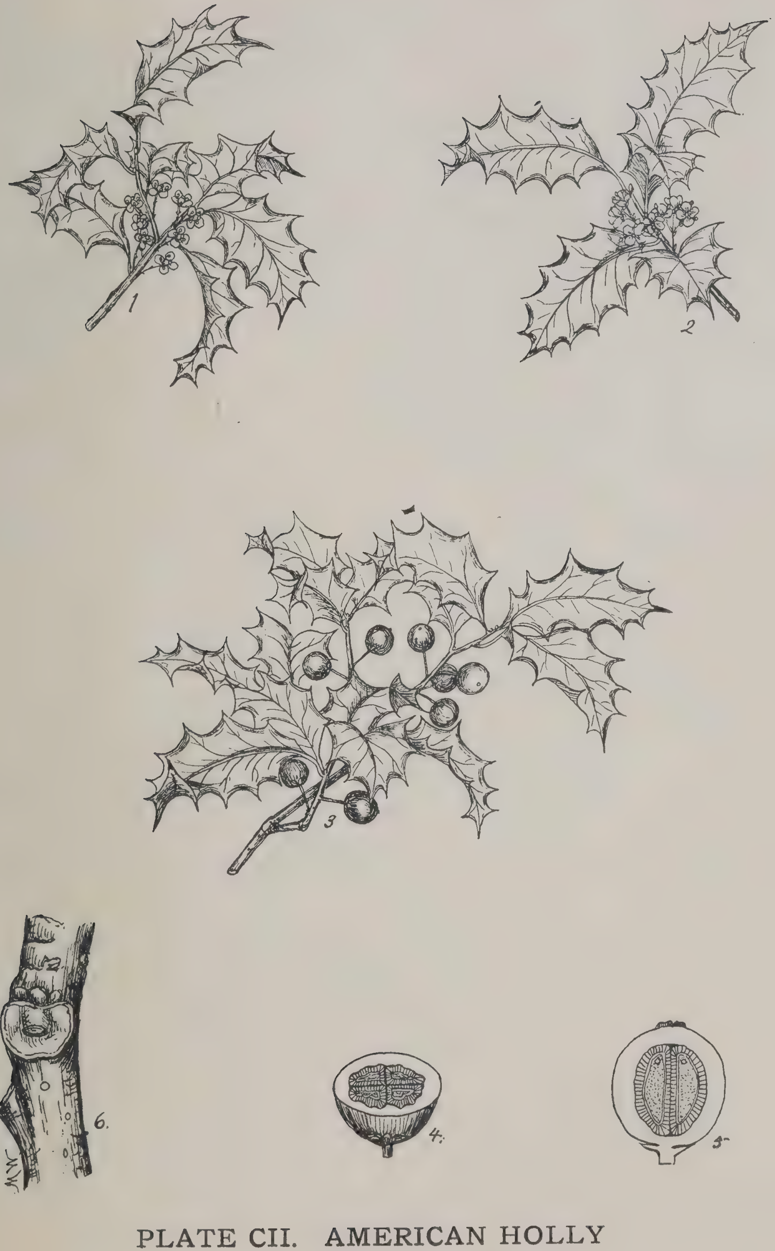

PLATE CII. AMERICAN HOLLY

1. A pistillate flowering branch, x ½.
2. A staminate flowering branch, x ½.
3. A fruiting branch, x ½.
4. Cross section of a fruit, enlarged.
5. Longitudinal section of a fruit, enlarged.
6. Section of a twig, enlarged.

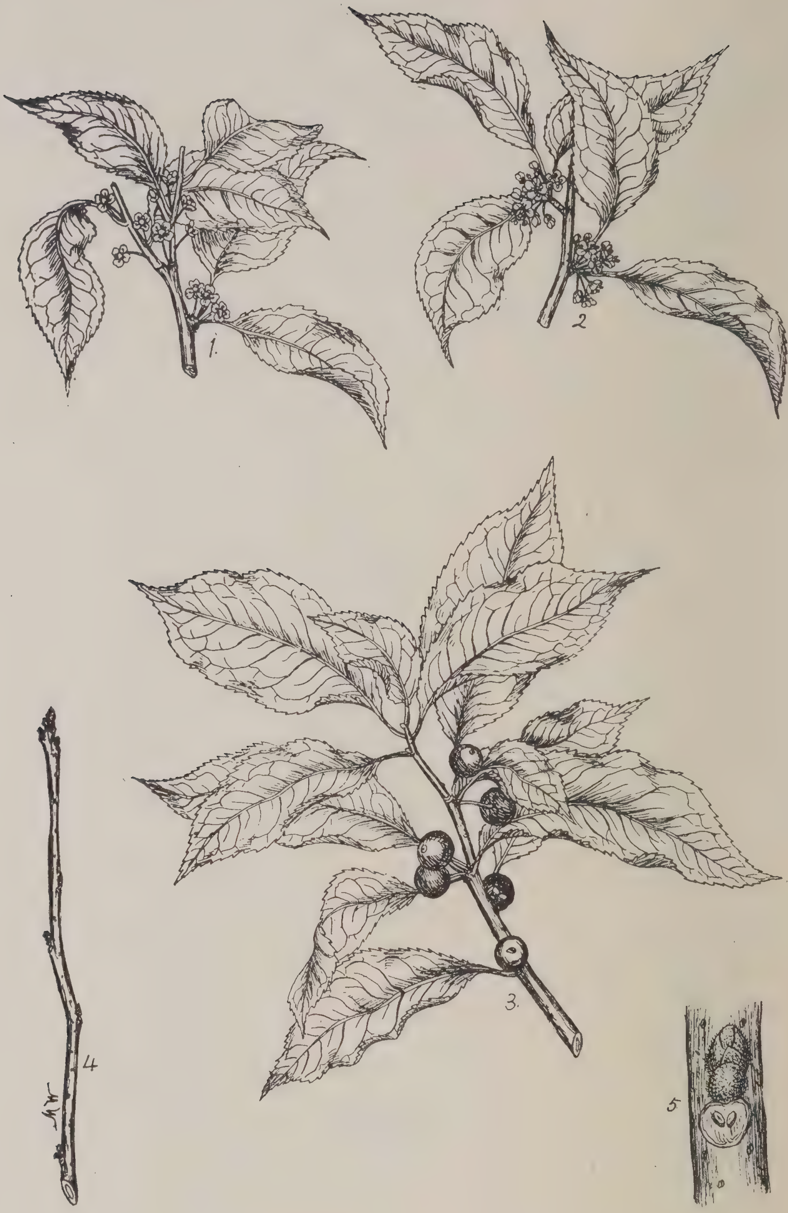

PLATE CIII. LARGE-LEAVED HOLLY

1. A pistillate flowering branch, x ½.
2. A staminate flowering branch, x ½.
3. A fruiting branch, x ½.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.

LARGE-LEAVED HOLLY

Ilex monticola, Gray

FORM—A shrub or small tree usually less than 20 ft. in height but may reach a height of 40 ft. with a diameter of 12 inches. It reaches its largest size in North and in South Carolina. Trunk, short, bearing a rather wide and deep crown formed by slender, spreading, ascending branches.

BARK—Thin, light brown, rough, warty, covered with numerous lenticels.

TWIGS—Smooth, reddish-brown, becoming dark gray, enlarged at nodes; with decurrent ridges running down from leaf-scars; round, marked by many small lenticels at first indistinct but later conspicuous. Pith round, narrow, light yellowish-green.

BUDS—Alternate, terminal bud present; lateral buds often superposed and covered with gaping scales: broadly ovate to globular, small, about ⅛ of an inch long, sharp-pointed or occasionally blunt-pointed. Bud-scales ovate, keeled, sharp-pointed, light brown, finely hairy at apex.

LEAVES—Alternate, simple, deciduous, 4-5 inches long, ½-2 inches wide, ovate or lanceolate-oblong, taper-pointed at apex, sharply serrate on margin, tapering or rounded at base, thin, smooth, dark green above, paler below.

LEAF-SCARS—Alternate, elliptical to broadly triangular, very small, inclined toward twig. Bundle-scars solitary, lunate to almost circular.

FLOWERS—Appear on short lateral stalks about June, when the leaves are almost developed; white or nearly so, small, about ⅓ of an inch across. Staminate clustered, borne upon pedicels about 2/5 of an inch long; pistillate solitary or few in a cluster, on very short pedicels.

FRUIT—Matures about September. Bright scarlet, globose, about 2/5 of an inch in diameter containing 4-6 nutlets; nutlets narrowed at the ends, striate, prominently many-ribbed on the back.

WOOD—Diffuse-porous; hard, close-grained, nearly white. In general resembles that of the American Holly, page 194. Weighs about 41 lbs. per cubic foot. Not found on the market.

DISTINGUISHING CHARACTERISTICS—The Mountain Holly may be distinguished by its small size, its small clustered white flowers, its bright, scarlet globose clustered fruit with striate many-ribbed nutlets, its ovate or lanceolate-oblong, smooth, sharply-serrate, dark green deciduous leaves, its small leaf-scars each with a solitary bundle-scar, and its bitter reddish-brown twigs marked by many small lenticels and decurrent ridges below the leaf-scars. The closely related Black Alder or Winterberry (**Ilex verticillata**) has many characteristics in common with this species but may be distinguished by its smooth and even nutlets, its flowers which are all short-stalked, and its leaves which are more downy on the lower surface.

RANGE—New York to Georgia and Alabama.

DISTRIBUTION IN PENNSYLVANIA—Rather common in the mountainous parts of the State. Rare or absent in other parts.

HABITAT—Usually found in mountain woods. Prefers rich, moist, often rocky situations. Frequently occurs in shaded places under a dense canopy of larger trees.

IMPORTANCE OF THE SPECIES—The Large-leaved Holly is of little forestal importance. It remains small, grows slowly and occurs scattered or in small clumps. Its bright foliage and brilliant fruit recommend it for ornamental purposes. It reaches tree-size only in the South.

THE MAPLE FAMILY—ACERACEAE

The Maple family comprises in addition to the Asiatic genus Dipteronia, with only 1 species, about 70 species, all of which are included in the genus Acer, and distributed with a few exceptions in the northern hemisphere. This family consists mainly of trees and a few shrubs. The members of this family are used more than those of any other family as ornamental and shade trees. Further characteristics of the family are included in the description of the sole American genus.

THE MAPLES—ACER, (Tourn.) L.

This genus comprises approximately 70 species in the world, with 13 species in the United States and 6 species in Pennsylvania. A few exotic species have been introduced exclusively for ornamental and shade purposes. The commonest exotic species are the Norway Maple (Acer platanoides L.) and the Sycamore Maple (Acer Pseudoplatanus L.). On account of their abundance and wide distribution in this State, a descriptive page, together with an accompanying plate, has been devoted to these two species.

The leaves of the Maples are opposite, usually simple or in a few species compound with 3-5 leaflets, and are shed in the autumn. The flowers are regular or Polygamous, rarely perfect, and appear before, with or after the leaves. The time at which the flowers appear aids considerably in distinguishing the various species from each other. Some trees bear only staminate flowers, while others bear only pistillate, with the result that one may occasiionally find a mature tree which does not produce any fruit. The flowers are pollinated by insects, which are attracted in hordes by the aromatic pollen-bearing blossoms. The fruit is composed of a pair of winged seeds joined together to form the well-known maple key or samara, which matures in early or late summer, depending upon the species. The fruit which matures in early summer germinates at once, while that which matures in late summer remains dormant over winter and germinates the following spring. Wind is the chief agent which disseminates the seeds.

The Maples are separated into two classes with reference to their commercial value, Hard Maple and Soft Maple. This classification is based upon the physical characteristics of the wood. The wood of the Maple is diffuse-porous with rather small medullary rays usually fine-grained, dense, and in some species hard and beautifully curled and figured, which makes it especially prized for interior finish and cabinet work. Most species yield a saccharine sap which may be concentrated into maple syrup or maple sugar.

Within a family one may often find a wide variation of plant organs, but the genus Acer possibly presents a wider range or a greater variation in its organs than any other genus of trees found in this State. The leaves may be simple or compound, large or small, smooth or hairy. The twigs may be green, brown, or red. The flowers may be in small lateral clusters, in long terminal racemes, or in drooping clusters; appear before, with or after the leaves. Their color may be green, yellow, or red. The fruit, while similar in all the species so far as type is concerned, varies considerably in size, divergence of the wing, and arrangement. Their habitat also varies, some like the Red Maple, preferring moist locations, while the Mountain Maple frequents rocky situations. In addition to these general differences among the species, a greater difference becomes evident as one studies the detailed description of the species which follows:

SUMMER KEY TO THE MAPLES

Page

1. Leaves simple, ...2
1. Leaves pinnately compound, ...A. Negundo 203

2. Leaf petioles with acrid milky sap, ...A. platanoides 204
2. Leaf petioles without acrid milky sap, ...3

3. Flowers in terminal racemes, ...4
3. Flowers in lateral clusters, appearing before or with the leaves, ...6

4. Flowers appear with the leaves, ...A. Pseudo-platanus 204
4. Flowers appear after the leaves, ...5

5. Flowers in erect racemes; leaves coarsely serrate and usually 3-lobed, ...A. spicatum 199
5. Flowers in drooping racemes; leaves finely serrate, 3-lobed at apex, at first brown pubescent beneath, ...A. pennsylvanicum 198

6. Flowers opening before the leaves, the drooping fruit ripening in spring or early summer, ...7
6. Flowers opening with the leaves, drooping fruit ripening in summer or early autumn, ...A. saccharum 200

7. Flowers with petals; leaves bright green above, pale green nearly glabrous beneath, 3-5-lobed; fruit keys incurved, ...A. rubrum 202
7. Flowers without petals; leaves green above, whitish or silvery beneath, deeply 5-lobed; fruit keys divergent, ...A. saccharinum 201

WINTER KEY TO THE MAPLES

1. Buds stalked, with few exposed scales, ...2
1. Buds sessile or nearly so, with 6 or more exposed scales, ...4

2. Buds evidently-stalked; bark streaked longitudinally with white lines, ...A. pennsylvanicum 198
2. Buds short-stalked; bark not streaked longitudinally with white lines, ...3

3. Buds small, 1/5 of an inch long including stalk; twigs reddish-brown to dingy gray; pith brown, ...A. spicatum 199
3. Buds large, ovoid, the terminal one acute, the lateral obtuse and closely appressed; twigs greenish-purple and glaucous; pith light, ...A. Negundo 203

4. Buds with 8-16 exposed scales, brown, acute, non-collateral, leaf-scars nearly encircle stem, ...A. saccharum 200
4. Buds with 6-8 exposed scales, red or green, obtuse, ...5

5. Terminal buds small, generally less than 1/5 of an inch long; terminal and lateral buds of same size; collateral buds present, ...6
5. Terminal buds large, generally over 1/5 of an inch long; terminal buds larger than lateral; collateral buds absent, ...7

6. Twigs red and lustrous; bark rough but not flaking in large pieces, ...A. rubrum 202
6. Twigs bright chestnut-brown; bark falling away in thin large flakes, ..A. saccharinum 201

7. Buds red; leaf-scars encircle stem; lenticels scattered; lateral buds appressed; bark black, fissuered, not scaly, ...A. platanoides 204
7. Buds green; leaf-scars do not encircle stem; lenticels numerous; lateral buds projecting; bark brownish and scaly, ...A. Pseudo-platanus 204

STRIPED MAPLE

Acer pennsylvanicum, Linnaeus

FORM—Usually from 10-25 ft. in height with a diameter of about 6-12 inches, but may attain a height of 40 feet. Trunk usually short dividing into slender and straight branches which form a deep and broad crown.

BARK—Thin, rather smooth, greenish or reddish-brown, conspicuously marked with longitudinal white streaks; later becomes rougher, darker, and less streaked. See Fig. 82.

TWIGS—Smooth, stout, at first greenish, later red, with very few inconspicuous lenticels, and brown pith. Season's growth marked by 2 or sometimes 3 dark lines encircling the twig, formed by fallen outer bud-scales. White longitudinal streaks appear the second season.

BUDS—Opposite, evidently-stalked, large, about 2/5 of an inch long excluding stalk, tapering but blunt-pointed, red, glossy, angular, covered by a single pair of red, smooth, valvate scales enclosing a few pairs of smaller and lighter scales. Outer scales are smooth on surface with ciliate margins while the inner scales are hairy as shown in opposite plate. Terminal buds are large while lateral buds are smaller and closely appressed.

LEAVES—Opposite, simple, goose-foot-like, 3-lobed at apex, finely serrate on margin, rounded at base, rusty-pubescent below. Petioles long, grooved, with enlarged bases.

LEAF-SCARS—Opposite, broadly U-shaped, nearly encircles stem; adjacent edges form rather blunt teeth which are separated by a ridge. Bundle-scars usually 3, often subdivided into 5-8.

FLOWERS—Appear in May or June after the leaves are full grown in drooping terminal racemes. Staminate and pistillate flowers occur on same plant but in different clusters.

FRUIT—Matures in September in drooping racemes; wings of the keys thin, very divergent, about $\frac{3}{4}$ of an inch long, marked on one side of seed with a depression.

WOOD—Diffuse-porous; soft, close-grained, light brown with wide zone of sapwood. Seldom used commercially. Weighs 33 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Striped Maple, also known as Moosewood, Whistle Wood, Streaked Maple (Potter county), and Seven Bark (Huntingdon county), can be readily distinguished at all seasons of the year by the light longitudinal streaks on the branches and trunk. They often appear the second year and persist for many years on the trunk. In winter the large, evidently-stalked, valvate, and red buds together with the smooth branches and brown pith are characteristic. In summer the drooping raceme of flowers and the goosefoot like leaves with their finely serrate margins and rusty pubscence on the lower surface are distinctive.

RANGE—From Nova Scotia west to Minnesota, south especially along the mountains to Georgia.

DISTRIBUTION IN PENNSYLVANIA—Rather common locally in the mountainous parts of the State especially on shaded slopes and in deep ravines. Very common in Mifflin, Centre, Blair, and Huntingdon counties.

HABITAT—It prefers moist, cool, shaded, often rocky mountain slopes.

IMPORTANCE OF THE SPECIES—The wood of the Striped Maple is of practically no commercial value. The chief value of the tree is its attractive ornamental qualities both as an individual tree and as a component of the understory of the forest structure.

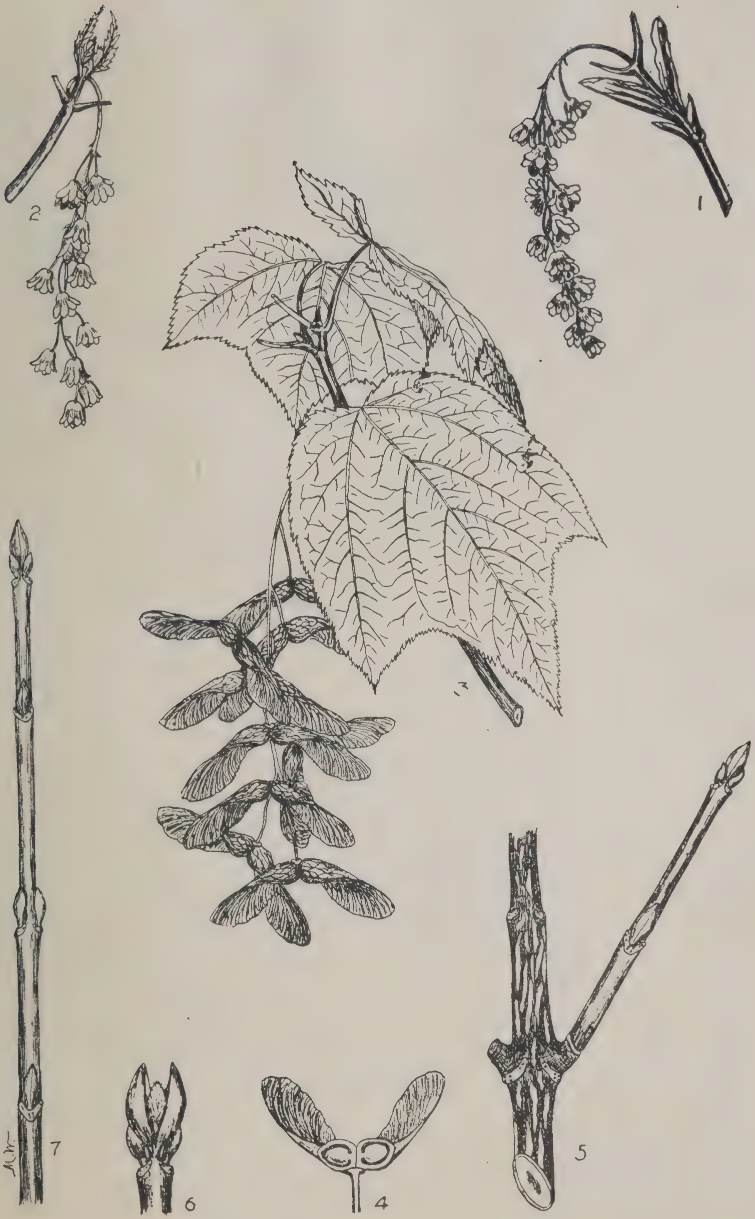

PLATE CIV. STRIPED MAPLE

1. Branch with drooping raceme of staminate flowers, x ½.
2. Branch with drooping raceme of pistillate flowers, x ½.
3. Branch with mature leaves and drooping raceme of fruit, x ½.
4. A maple key with exposed seeds, x ½.
5. Section of winter branch showing striped bark, buds, and leaf-scars, x ½.
6. Terminal section of winter twig showing evidently stalked buds with outer pair of bud scales separated, exposing the pubescent inner scales, natural size.
7. Section of winter twig showing opposite and stalked buds, and leaf-scars with bundle-scars, x ½.

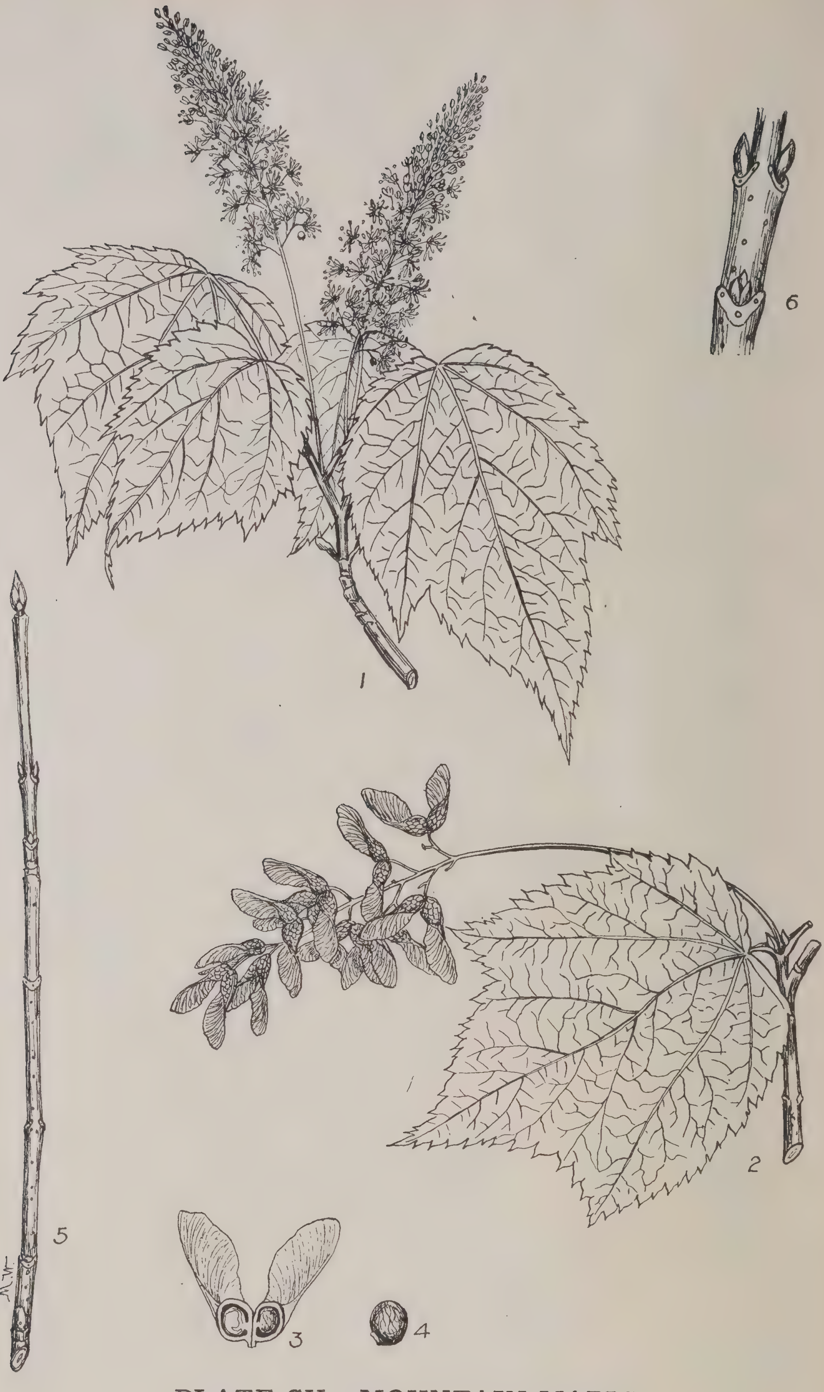

PLATE CV. MOUNTAIN MAPLE

1. Branch with mature leaves and two erect racemes of flowers, x ½.
2. Branch with a mature leafe and a raceme of fruit, x ½.
3. A maple key with exposed seeds, x ½.
4. A seed, slightly enlarged.
5. Winter twig with buds, lenticels, and leaf-scars with bundle-scars, x ½.
6. Section of a winter twig, enlarged.

MOUNTAIN MAPLE

Acer spicatum, Lambert

FORM—A shrub or small tree sometimes attaining height of 35 ft. with a diameter of 11 inches. Usually a shrub growing in clumps on rocky soil. Trunk usually short and bears rather straight, slender and upright branches.

BARK—Thin, rather smooth, brown or grayish-brown mottled with dingy-gray blotches.

TWIGS—Slightly hairy, at first reddish-purple on exposed side and yellowish-green on shaded side, later bright red and then changing to grayish-brown, covered with few scattered lenticels; contain brown pith, and are encircled by 2 or 3 dark rings formed by the scars of fallen bud-scales.

BUDS—Opposite, short-stalked, rather small, about ¼ of an inch long including stalk; terminal buds larger and more acute-pointed than lateral appressed buds; one pair or sometimes two pairs of more or less hairy, grayish or greenish scales visible.

LEAVES—Opposite, simple, 3-5 lobed, coarsely serrate on margin, cordate at base, somewhat hairy on lower surface. Petioles long, slender, and enlarged at base.

LEAF-SCARS—Opposite, V-shaped, hollow, with 3 bundle-scars, and nearly encircle stem.

FLOWERS—Appear about June after the leaves are full grown, in erect terminal racemes. Staminate flowers occur usually at the top and the pistillate at the base of the raceme.

FRUIT—Matures in September in drooping racemes; wings of the keys somewhat divergent, about ½ of an inch long, the seed-bearing part strongly striated.

WOOD—Diffuse-porous; soft, close-grained, light to reddish-brown with wide zone of light sapwood. Seldom used commercially. Weighs 33 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Mountain Maple, also known as Spotted Maple, is essentially a shrubby species growing in small clumps, and can be distinguished from most species of Maple by its stalked, few-scaled winter buds, erect racemes of flowers, hairy-purplish to greenish-twigs, and simple, 3-5 lobed coarsely serrate leaves. It differs from the closely related Striped Maple in the absence of light-striped bark and brown pubescence on the lower sides of the leaves, and in the presence of pubescence on the branches, and smaller often gaping buds.

RANGE—Newfoundland to Manitoba, south to Michigan, Pennsylvania, and along the mountains to Georgia.

DISTRIBUTION IN PENNSYLVANIA—Found locally in all parts of the State. Rather common in the mountainous parts. Very rare in the southeastern part. Local in the western part.

HABITAT—It prefers moist rocky hillsides. Commonly found bordering ravines. It demands the shade of other trees. Very thrifty on the moist slopes and tops of the southern Appalachian Mountains.

IMPORTANCE OF THE SPECIES—The Mountain Maple is of practically no commercial importance as a timber tree, but is valuable as a soil protector on rock slopes where a protection forest is desirable. This species is planted very extensively for ornamental purposes.

SUGAR MAPLE

Acer saccharum, Marshall

FORM—A large timber tree attaining a maximum height of 120 ft. with a diameter of 5 feet. Open grown trees have short trunks bearing stout, rather erect branches which form a spreading, egg-shaped, often round-topped crown. Trees in closed stands have long, straight, clean trunks bearing shallow, round crowns with large limbs.

BARK—On branches and young trunks smooth and light brown; on older trunks brown, deeply channelled into long irregular plates or flakes which often loosen vertically along the side. See Fig. 81.

TWIGS—Slender, smooth, reddish-brown to orange-brown, covered with numerous pale lenticels.

BUDS—Opposite, brown, sharp-pointed, conical, hairy at apex; terminal but about twice as ing but blunt-pointed, red, glossy, angular, covered by a single pair of red, smooth, valvate

LEAVES—Opposite, simple, usually 5-lobed, with a sparsely toothed margin and round-based sinuses, cordate at base, thin in texture, 3-5 inches long and greater in width. Mature leaves are bright green above and pale green below.

LEAF-SCARS—Opposite, V-shaped to U-shaped, nearly encircling stem. Bundle-scars usually 3, in a lunate line.

FLOWERS—Appear in April and May with the leaves, in drooping corymbs both from the terminal mixed buds and the lateral propagative buds. The staminate and pistillate occur in different clusters.

FRUIT—Matures about September; clustered, borne on drooping stalks; wings of the keys about ½-1 inch long, parallel, or slightly divergent.

WOOD—Diffuse-porous; heavy, hard, close-grained, with fine surface, light brown to reddish. Used for interior finish, furniture, shoe lasts, railroad ties. Abnormal modifications of the structure of the wood known as Curly Maple and Bird's Eye Maple are rather common and especially prized in cabinet making. Weighs 43 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Sugar Maple, also known as Hard Maple and Rock Maple, can be distinguished in summer from the other Maples by its large, simple leaves which are thin in texture and have their lobes coarsely toothed. The flowers appear with the leaves while those of the Red Maple and the Silver Maple appear before, and those of the Mountain Maple and the Striped Maple after the leaves. The fruit clusters of the Sugar Maple are usually developed from terminal buds while those of the Red Maple and Silver Maple are developed from lateral buds. The fruit of the Sugar Maple does not mature until September and may often persist into the winter while the fruits of the Red Maple and Silver Maple mature in early summer and germinate at once after falling upon the ground. In winter the Sugar Maple can be recognized by its conical, sharp-pointed, brown buds with from 8-16 exposed and overlapping scales, and by the slender brown twigs marked with pale lenticels. The rough furrowed trunk is also characteristic of older trees. The Black Sugar Maple (Acer saccharum var. nigrum) occurs locally. It is commonest in the mountains and western parts of the State. The lower surface of the leaves is usually green, sometimes downy. The lobes of the leaves are entire or undulate, while those of the Sugar Maple are coarsely dentate. It is common in Greene county.

RANGE—Newfoundland to Manitoba, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common, especially in the northern, western, and eastern parts of the State. It is possibly, next to Chestnut, the commonest tree in this State.

HABITAT—It flourishes best on well-drained rich soil, but will thrive even when the soil is not rich. It is common on low ridges at the base of the mountains, and along slopes. It reaches its best development in central New England, New York, northern Pennsylvania, and the Lake States.

IMPORTANCE OF THE SPECIES—The Sugar Maple is a valuable timber tree. Its importance is being realized more as the wood finds new uses. The process of timber impregnation has raised the value of the wood of this species. It is not only valuable as a timber tree but produces annually a large quantity of maple sugar and maple syrup, and in addition is one of our most attractive ornamental trees.

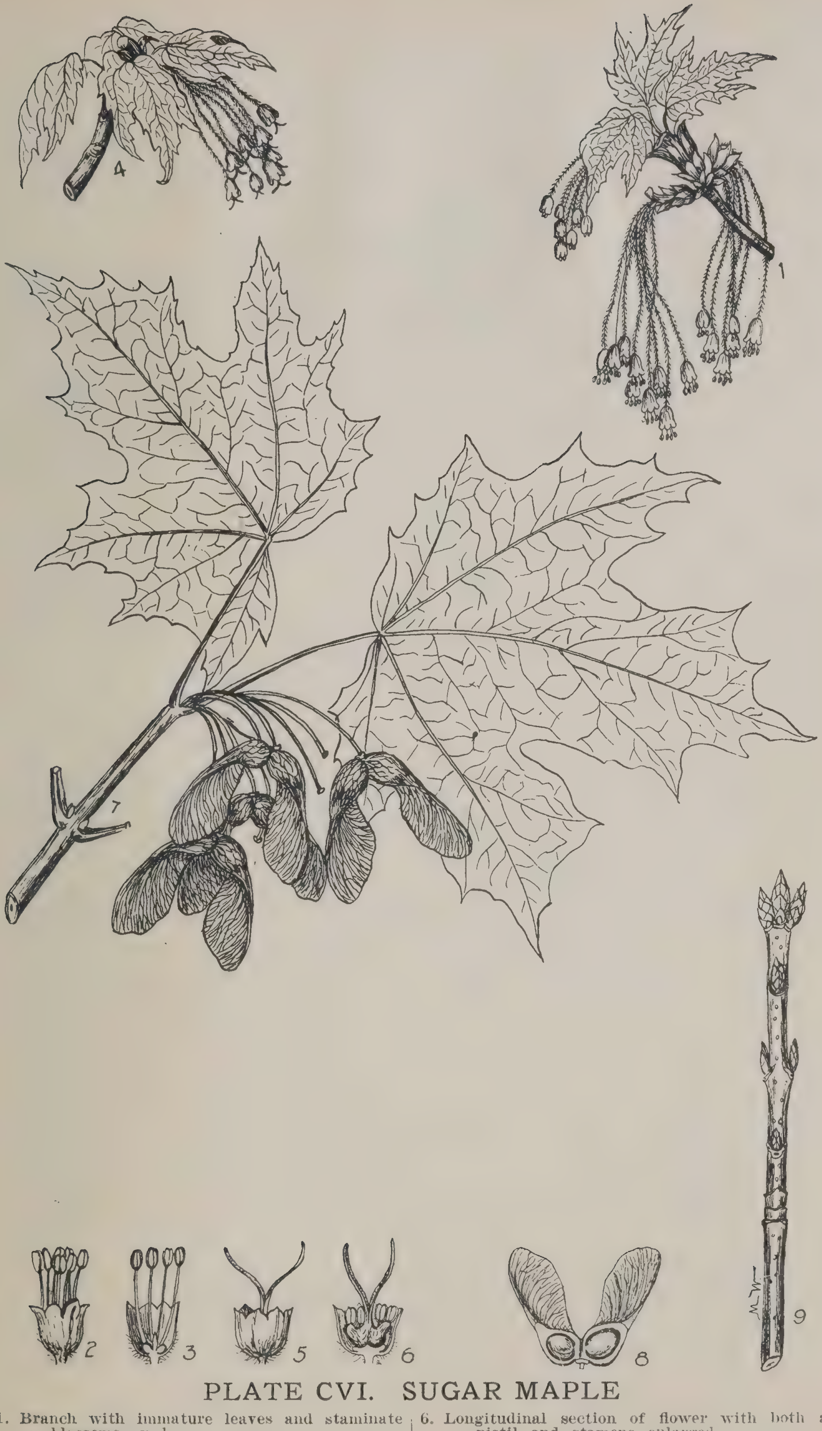

PLATE CVI. SUGAR MAPLE

1. Branch with immature leaves and staminate blossoms, x ½.
2. Staminate flowers with calyx, enlarged.
3. Longitudinal section of staminate flower, enlarged.
4. Branch with immature leaves and pistillate blossoms, x ½.
5. Pistillate flower with calyx, enlarged.
6. Longitudinal section of flower with both a pistil and stamens enlarged.
7. Branch with mature leaves and cluster of fruit, x ½.
8. A maple key with exposed seeds, x ½.
9. Winter twig showing lenticels, leaf-scars, bud-scale scars, and sharp pointed opposite buds, x ½.

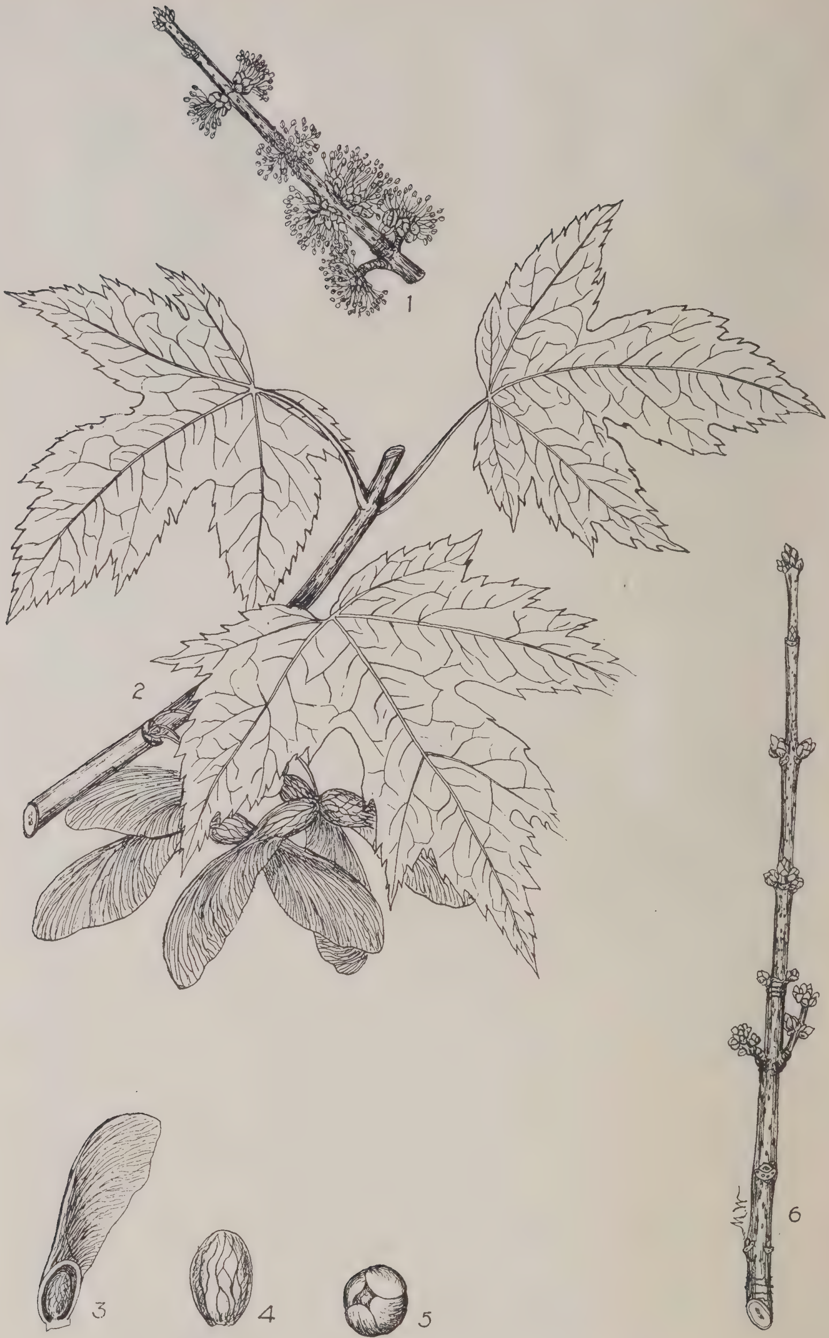

PLATE CVII. SILVER MAPLE

1. Flowering branch, x ½.
2. Branch with mature leaves and mature fruit, x ½.
3. A wing of a maple key with exposed seed, x ½.
4. A seed, enlarged.
5. End view of a seed, enlarged.
6. A winter twig showing buds, lenticels, leaf-scars, bud-scale scars and bundle-scars, x ½.

SILVER MAPLE

Acer saccharinum, Linnaeus

FORM—Usually a tree about 50-60 ft. in height but may attain a maximum height of 120 ft. with a diameter of 4½ feet. Trunk short and divides into lateral branches which again freely subdivide and form a broad head. Lateral branches have pronounced droop, and distinct upward curve at the end.

BARK—On branches and young trunks smooth and gray; on old trunks brown with a somewhat furrowed surface separating into thin flakes which are fastened at the center and loose at both ends.

TWIGS—Somewhat slender, glossy, at first green, later bright chestnut-brown, covered with numerous light lenticels.

BUDS—Opposite, red, obtuse-pointed, sessile or short-stalked; flower buds stout, spherical, accessory, covered with overlapping scales, 6-8 of which may be exposed. Margin of scales ciliated and often light in color.

LEAVES—Opposite, simple, 5-lobed, coarsely toothed; bright green on upper surface and silvery-white on lower; with deep round-based sinuses.

LEAF-SCARS—Opposite, U-shaped to V-shaped, not encircling stem. Bundle-scars 3, in a lunate line.

FLOWERS—Appear in March or April before the leaves are out, in dense, sessile, axillary clusters. Staminate and pistillate occur in separate clusters sometimes on the same, sometimes on different trees. Petals absent.

FRUIT—Matures about May; clustered along branchlets, borne on slender drooping stalks; wings of the keys usually from 1-2 inches long, divergent, sometimes straight, or curved.

WOOD—Diffuse-porous; moderately hard, rather brittle, close-grained, with wide sapwood. Used for flooring, cheap furniture, and paper pulp. Weighs 33 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Silver Maple, also known as White Maple, River Maple, and Soft Maple, can be recognized in summer by its leaves with a silvery-white lower surface and deep round-based sinuses. In winter it closely resembles the Red Maple but may be distinguished from it by the pungent odor of the broken twigs and their chestnut-brown color. The bark of the Silver Maple is somewhat furrowed and separates into thin flakes which are loose at both ends and fastened in the middle. The lateral branches have a pronounced droop and a distinct upward curve at the ends. This may sometimes be a distinctive character. The Red Maple and the Silver Maple are distinguished from all the other Maples of the State by the numerous, round, red, collateral buds.

RANGE—New Brunswick to southern Ontario, south to Florida and Indian Territory.

DISTRIBUTION IN PENNSYLVANIA—Occasional and local throughout the State, especially along larger streams. One of the prevailing trees along the lower part of the Conococheague creek in Franklin county, but does not occur about the headwaters of this stream. It is generally absent at higher elevations.

HABITAT—It prefers a moist deep soil such as is found along stream banks. It will exist in drier locations but not attain a large size.

IMPORTANCE OF THE SPECIES—The Silver Maple is a very attractive ornamental tree. A few special ornamental varieties have been developed. The wood is brittle and consequently the branches are apt to be broken off during a storm. This defect somewhat checks the planting of this species in exposed places. It is a rapid grower. The wood which it produces is of no special commercial importance and consequently it has little to recommend it for forestry purposes, except that it forms an excellent soil cover in the understory of the forest.

RED MAPLE

Acer rubrum, Linnaeus

FORM—Usually a tree about 50 ft. high, but in a moist habitat sometimes attains a height of over 100 ft. with a diameter of 4 feet. When grown in the open it branches near the ground and forms a deep, broad, dense crown. Upper lateral branches are rather upright while lower ones are horizontal and slightly turned upwards at the end.

BARK—On branches and young trunks smooth and gray; on old trunks dark grayish, thick, shaggy, and roughened by long ridges which peel off in long plates. See Figs. 79 and 80.

TWIGS—Somewhat slender, glossy, at first green, later red, covered with numerous light lenticels.

BUDS—Similar to those of the Silver Maple. See page 201.

LEAVES—Opposite, simple, 3-5-lobed, coarsely-toothed, light green above, pale green to whitish below, with rather shallow sharp-based sinuses.

LEAF-SCARS—Opposite, U-shaped to V-shaped, not encircling stem. Bundle-scars 3, in a lunate line.

FLOWERS—Appear in March or April before the leaves are out, in dense sessile axillary clusters. Staminate and pistillate occur in different clusters, on the same or different trees. Petals present.

FRUIT—Matures in May or June; clustered and borne on drooping stems; wings of the keys usually less than 1 inch long, red to brown in color, at first convergent but later divergent.

WOOD—Diffuse-porous; rather soft, not strong, close-grained, light brown with wide light sapwood. Used for furniture, in turnery, and paper pulp. Weighs 38 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Red Maple, also known as Soft Maple, Swamp Maple, and White Maple, can be recognized in summer by its simple, rather small, 3-5-lobed, coarsely-toothed leaves which are rarely silvery-white underneath, and have rather shallow sharp-based sinuses. In winter it closely resembles the Silver Maple, but may be distinguished by its red lustrous twigs and the absence of a pungent odor from broken twigs. In winter these two closely related species can be distinguished from the Sugar Maple by their numerous, round, red, collateral buds; from the Striped Maple and the Mountain Maple by their larger size and the absence of stalked buds; from the Ash-leaved Maple by the absence of short-stalked downy buds and greenish twigs covered with a whitish bloom. The European species, both Norway Maple and Sycamore Maple, have much larger buds and stouter twigs.

RANGE—Nova Scotia to Manitoba, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common locally throughout the State, especially in regions traversed by streams and in wet habitats.

HABITAT—It prefers wet soil, often found in swamps but also frequents drier hillsides. Commonly found along rivers, creeks, lakes, in swamps, and as an undergrowth in the forest over extensive and often rather hilly areas.

IMPORTANCE OF THE SPECIES—The Red Maple produces a wood which at present is of little commercial importance. It may in time become more valuable. The despised species of to-day may be the prized species of to-morrow. It is tolerant of shade and its chief future value in forestry may be in furnishing soil protection as a member of the understory of the forest. It may play the same role in our future forest that Beech is playing to-day in the intensively managed forests of Germany, only that it is of less value for fuel.

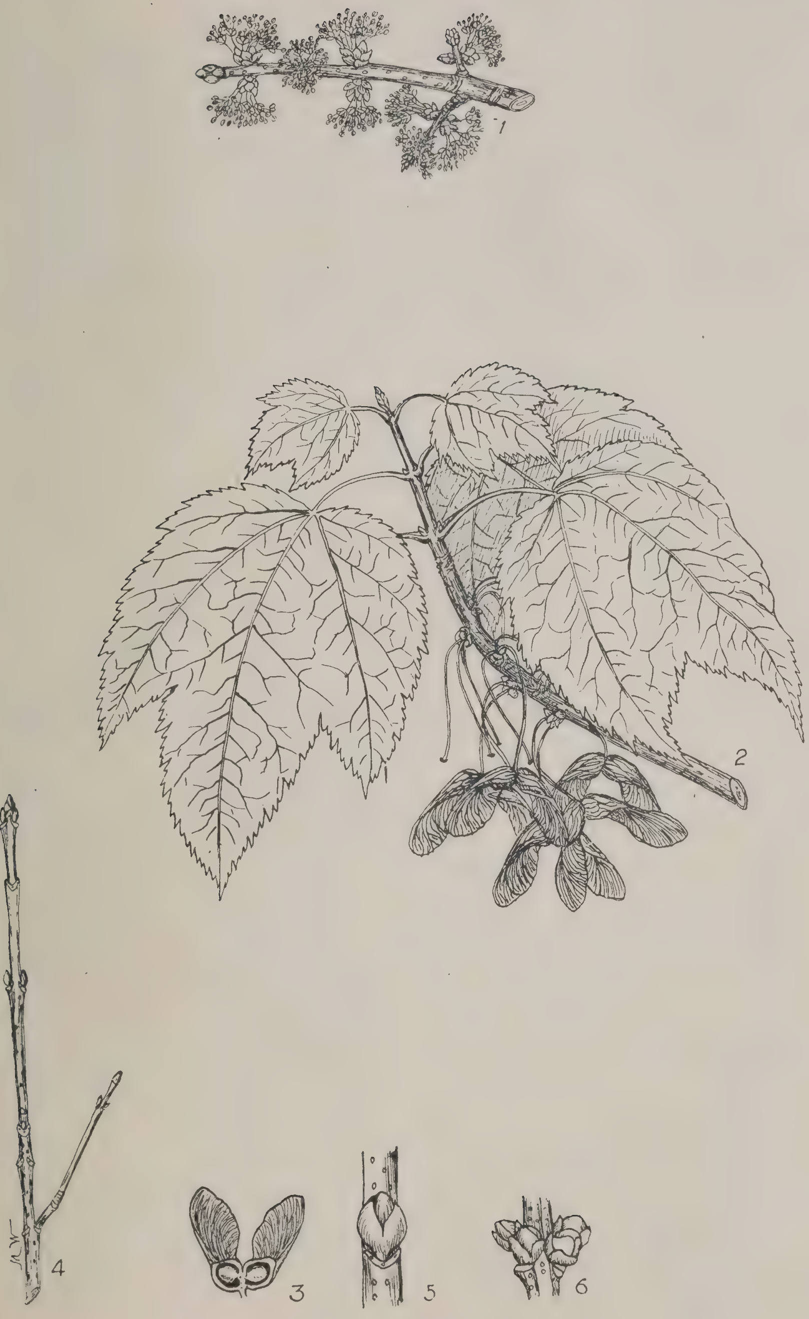

PLATE CVIII. RED MAPLE

1. Flowering branch, x ½.
2. Branch with mature leaves and mature fruit, x ½.
3. A maple key with exposed seeds, x ½.
4. A winter branch, x ½.
5. Section of winter twig showing lenticels, a leaf-scar and a gaping lateral bud, natural size.
6. Section of twig showing conspicuous lenticels and a cluster of accessory buds, natural size.

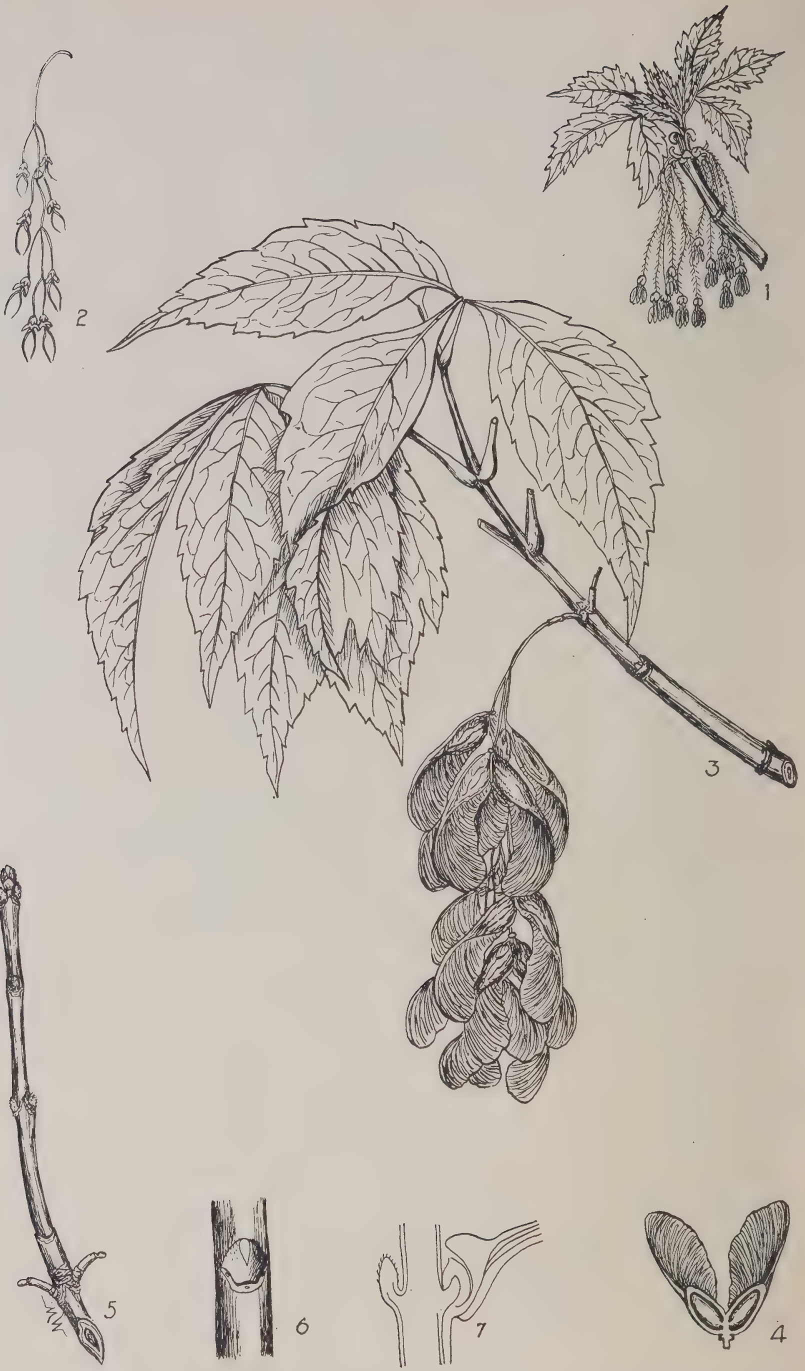

PLATE CIX. ASH-LEAVED MAPLE, or BOX ELDER

1. Branch with immature leaves and staminate blossoms, x ½.
2. A drooping raceme of pistillate blossoms, x ½.
3. Branch with mature leaves and a raceme of mature fruit, x ½.
4. A key of fruit with exposed seeds, x ½.
5. A winter twig, x ½.
6. Section of a winter twig showing a gaping bud and a leaf-scar with bundle-scars, enlarged.
7. Diagrammatic section of a twig with buds and a covering leaf-base, enlarged.

ASH-LEAVED MAPLE, or BOX ELDER

Acer Negundo, Linnaeus

FORM—A medium-sized tree occasionally attaining a height of 70 ft. with a diameter of 3 feet. Trunk usually short, dividing into stout, sometimes drooping branches which form a deep broad crown. Occasionally an open-grown tree possesses a long clean trunk.

BARK—On branches and young trunks smooth and grayish-brown; that of older ones rather thick, distinctly narrow ridged, and seldom scaly.

TWIGS—Stout, purplish-green or green, sometimes smooth, often covered with a whitish bloom and scattered raised lenticels.

BUDS—Opposite, short-stalked, large, ovoid; the terminal acute and the lateral obtuse; white woolly, covered by bud-scales, the outer pair usually completely enclosing the inner pair. Collateral buds are common and often distend outer scales.

LEAVES—Opposite, compound, with 3-5 leaflets. Leaflets ovate, coarsely and irregularly serrate, 2-4 inches long and 2-3 inches broad.

LEAF-SCARS—Opposite, V-shaped, bordered by light-colored margin, encircling stem so that adjacent edges of opposite scars meet at a very sharp angle. Bundle-scars usually 3, seldom divided, arranged in a lunate line.

FLOWERS—Appear in April before or with the leaves on the past season's growth. Staminate and pistillate occur on different trees, the former on hairy drooping pedicels, the latter in narrow drooping racemes.

FRUIT—Matures about September but is full grown earlier. Wings of the keys about 1½-2 inches long, parallel or incurved, borne in drooping racemes. Fruit-stalks persist far into winter.

WOOD—Diffuse-porous; light, soft, creamy-white, close-grained, not durable. Used in the manufacture of woodenware, cooperage, wood pulp, and sometimes in cheap furniture. Weighs 27 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Ash-leaved Maple, also known as Box Elder, is readily distinguished in summer by its opposite, compound leaves with 3 to 5 leaflets and its green branchlets covered with a whitish bloom. The maple keys arranged in drooping racemes are also characteristic. In winter the green branchlets are distinctive together with the large, ovoid, often collateral and downy buds. The leaf-scars encircle the stem and their adjacent edges form a very sharp angle.

RANGE—Vermont westward to Ontario, south to Florida, Texas, and Mexico.

DISTRIBUTION IN PENNSYLVANIA—Rare and local. Most abundant in the eastern and southern parts of the State. Common along the streams in the southwestern part. The prevailing tree along the lower part of the Conococheague creek in Franklin county, but entirely absent about the headwaters of this stream.

HABITAT—Thrives best in moist soil, but also tolerant of drier situations. Commonly found along streams, border of lakes or swamps. Often planted for ornamental purposes on dry locations.

IMPORTANCE OF THE SPECIES—The Ash-leaved Maple is of little commercial importance as a timber tree. It yields a sap from which some maple sugar is made locally. This tree is very attractive as an ornamental tree and is planted extensively as a shade, lawn, road-side and park tree. It grows rapidly and has an attractive form in winter and a dense green foliage in summer.

SYCAMORE MAPLE

Acer Pseudo-platanus, Linnaeus

The Sycamore Maple is a European species. It is native to central Europe where it attains a height of 120 ft. and develops a large spreading head. The trunk is sometimes furrowed and the bark flakes off in thin scales.

This tree is considered the most attractive of the Maples for ornamental planting. It is rather intolerant of soil conditions and consequently not planted so extensively as the Norway Maple.

The Sycamore Maple is readily distinguished by its firm, 3-5 lobed leaves with sharply serrate margins, acute-based sinuses, and pubescent lower leaf-surfaces. In winter the large, obtuse, green buds are characteristic together with the leaf-scars which do not quite encircle the stem. The lenticels are also more numerous and the lateral buds stands out from the twig more than on the Norway Maple. The fruit keys are also smaller and the wings less divergent than those of the Norway Maple.

NORWAY MAPLE

Acer platanoides, Linnaeus

The Norway Maple is a European species extending from Norway to Switzerland. It attains a height of 100 ft. and develops a round head. The trunk of the tree is closely fissured but not scaly.

This tree is one of our most attractive ornamental trees and is planted extensively along the streets in cities and in lawns and parks. It is especially adapted for city planting because it is more tolerant of unfavorable city conditions than our native Maples. It is also rather free from the attacks of insects and fungi, and retains the leaves longer in fall than our native species. The wood is of no commercial importance in America, but is used for minor purposes in Europe.

The Norway Maple can readily be distinguished in summer by its large leaves which resemble those of our Sugar Maple, but are deeper in color and firmer in texture. The large-toothed and almost entire-margined leaves are readily recognized from the smaller 3-5-lobed leaves of the Sycamore Maple with sharply serrate leaf-margins. A certain test for identifying the Norway Maple is the presence of milky sap in the leaf-petiole which readily exudes upon twisting. In winter the Norway Maple can be recognized by the large, obtuse, glossy, red buds which may be more or less olive-green at the base and by the lateral closely appressed buds. The leaf-scars which encircle the stem are also characteristic. The very divergent wings of the large maple keys and the closely fissured, but not scaly bark will also aid in recognizing it.

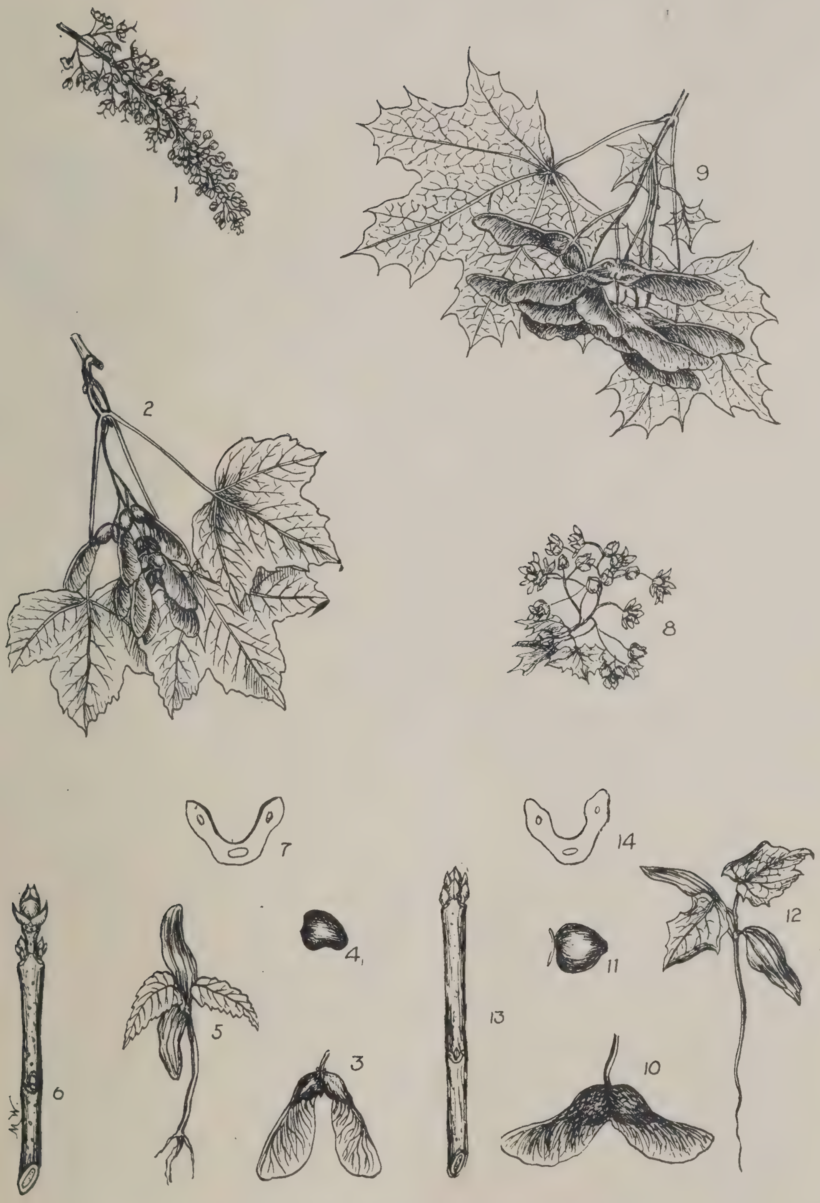

PLATE CX. EUROPEAN MAPLES

SYCAMORE MAPLE

1. A spike of flowers, x $\frac{1}{3}$.
2. Branch with leaves and fruit, x $\frac{1}{4}$.
3. A key of fruit, x $\frac{1}{3}$.
4. A seed, natural size.
5. A seedling, x $\frac{1}{4}$.
6 A winter twig, x $\frac{1}{2}$.
7. A leaf-scar, enlarged.

NORWAY MAPLE

8. A cluster of flowers, x $\frac{1}{4}$.
9. Branch with leaves and fruit, x $\frac{1}{5}$.
10. A key of fruit, x $\frac{1}{4}$.
11. A seed, natural size.
12. A seedling, x $\frac{1}{4}$.
13. A winter twig, x $\frac{1}{2}$.
14. A leaf-scar, enlarged.

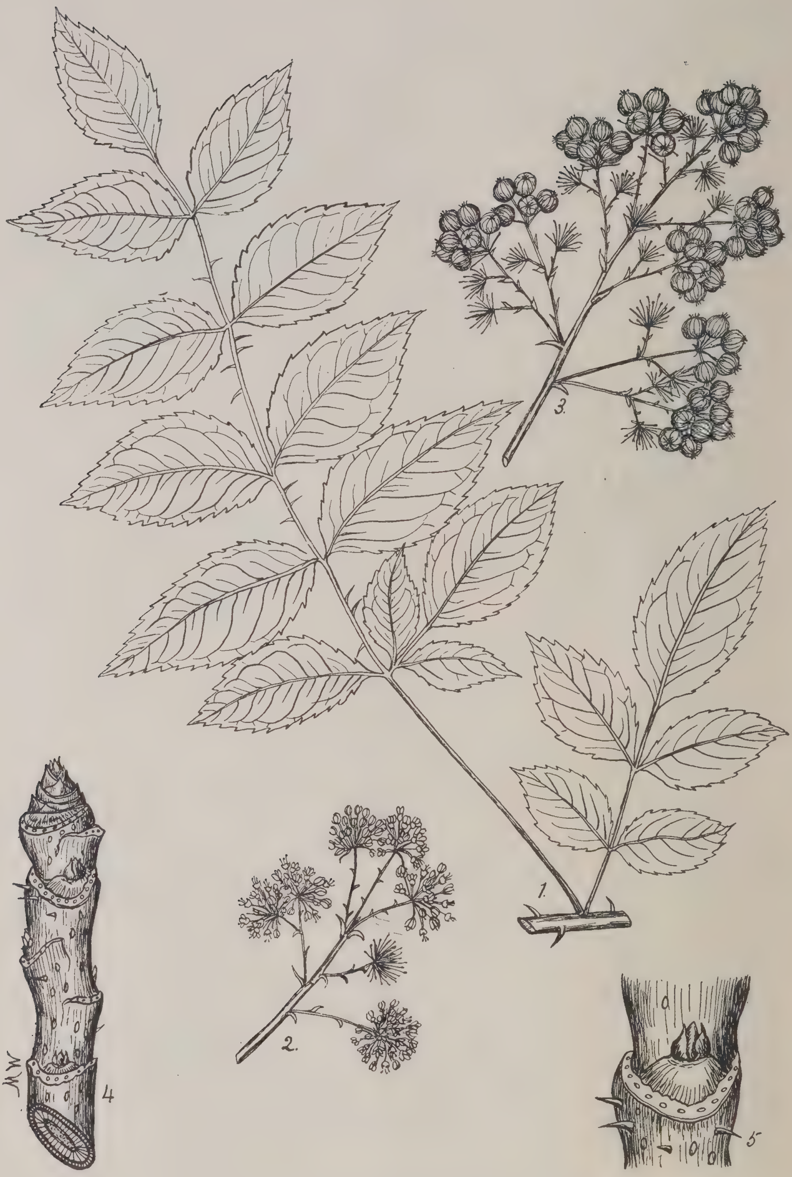

PLATE CXI. HERCULES' CLUB

1. Section of a branch with compound leaves, x ½.
2. A panicle of flowers, x ½.
3. A panicle of fruit, x ½.
4. A winter twig, x ½.
5. Section of a winter twig, natural size.

HERCULES' CLUB

Aralia spinosa, Linnaeus

FAMILY AND GENUS DESCRIPTION—This species belongs to the Ginseng family, Araliaceae, which comprises about 52 genera with 450 species of herbs, vines, shrubs, and trees. The members are widely distributed, but commonest in the tropics. The English Ivy (Hedera Helix L.) an evergreen climber, is one of its most common representatives. The Common Ginseng (Panax quinquefolium), is a well-known member of this family. The flora of Pennsylvania includes 2 genera with 6 species. The species described here is the only tree representative in North America. The genus Aralia to which it belongs comprises about 30 species, mostly herbs, native to North America and Asia.

FORM—It may attain a height of 40 ft. with a diameter of 12 inches, but usually 10-20 ft. in height with a diameter of 4-8 inches. Trunk may be branchless or sometimes covered with stout widespreading branches.

BARK—Thin, brown outside, yellow inside, at first smooth, later divided into rounded broken ridges.

TWIGS—Very stout, ½-⅔ of an inch in diameter, armed with stout, scattered prickles, roughened by long narrow leaf-scars which nearly encircle the twig.

BUDS—Alternate; terminal bud present, about ½-¾ of an inch long, chestnut-brown, conical, blunt-pointed. Lateral buds ¼ of an inch long, flattened, often triangular.

LEAVES—Alternate, compound or doubly compound, often 3 ft. long and 2-2½ ft. wide. Leaflets ovate, 2-3 inches long, thick, wedge-shaped or rounded at base, sharp-pointed at apex, serrate on margin, sometimes a little hairy on lower surface. Enlarged bases of the leaf-petioles sheath the twigs.

LEAF-SCARS—Alternate, narrow, long, about half encircle the twig, taper to a point, embrace lateral buds, stand in a horizontal position, i. e., their plane is often at right angles to the main axis of the twig. Each leaf-scar contains about 12 bundle-scars arranged in a curved line.

FLOWERS—Appear from June to August. Each flower is usually perfect and cream white. Many of them are grouped together in panicled-umbels which occur solitary or in groups often 3-4 ft. long.

FRUIT—An ovoid black berry about ¼ of an inch long, 5-angled, and terminated with blackened persistent styles.

WOOD—Soft, brittle, weak, close-grained, brown with yellow streaks; sapwood narrow.

DISTINGUISHING CHARACTERISTICS—The Hercules' Club, also known as Angelica Tree, can be distinguished by its large leaves which may be once twice, or thrice compound. The leaves are the largest of our native trees. They may be 3-4 ft. long and 2-2½ ft. wide. The petioles have enlarged clasping bases. The terminal buds are conical and ½-¾ of an inch long and the lateral ones are triangular and ¼ of an inch long. The elongated narrow leaf-scars half encircle the twigs. The stout twigs and the petioles are armed. The small white flowers are arranged in panicled-umbels often over 2 ft. long. Its habit of growth is unique in that a number of unbranched but armed stems may come up in rather dense clumps.

RANGE—Southern New York to Florida, west to Missouri and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the southern half of the State. Abundant in Potter county. Local outposts of it are reported from the northwestern part.

HABITAT—Prefers rich moist bottomland. Common in moist and fertile woodlands.

IMPORTANCE OF THE SPECIES—The Hercules' Club is of no commercial value. It remains small, produces inferior wood, and is local and limited in its distribution. This tree grows rapidly and is planted rather extensively for ornament.

FETID BUCKEYE

Aesculus glabra, Wildenow

FAMILY AND GENUS DESCRIPTION—The Soapberry family, Sapindaceae, comprises about 100 genera with more than 1,000 species. They are widely distributed, but commonest in the tropical regions of the Old World. The flora of North America comprises 6 genera of trees with about 13 species. The genus Aesculus alone has representatives in Pennsylvania. It comprises 14 species, 10 of which are native to America and 2 to Pennsylvania. In addition to the native species, the Horse-chestnut (Aesculus Hippocastanum) is widely introduced in this State.

FORM—Usually a small tree not over 40 ft. in height with a diameter of 12 inches, but may reach a height of 90 ft. with a diameter of 24 inches. Trunk short and slender. Crown broad, deep, round-topped.

BARK—Gray, thick, evidently-furrowed, breaking up into plates.

TWIGS—Stout, at first downy and brown, later smooth, reddish-brown to ashy-gray; ill-smelling if bruised. Pith large, light green, circular in outline.

BUDS—Opposite; terminal buds normally present but occasionally absent; about ⅔ of an inch long, sharp-pointed, resinous, covered by nearly triangular keeled scales. Outer bud-scales reddish-brown, finely hairy on margin, covered with a thin bloom; inner bud-scales yellowish-green, enlarging in spring to 1-2 inches and persisting until leaves are half developed.

LEAVES—Opposite, compound with 5, rarely 7, leaflets. Leaflets ovate to oval, 3-6 inches long, rather long-pointed at apex, narrow at base, irregularly and finely toothed on margin; when young rather hairy, later smooth, yellowish-green above, paler beneath. Leaf-stalks 4-6 inches long, stout, hairy when young, enlarged at base. Foliage ill-smelling if bruised.

LEAF-SCARS—Opposite, large, heart-shaped to inversely triangular. Bundle-scars large, usually in three groups of 3 to 9 each.

FLOWERS—Appear about April or May after the leaves are developed. Small, yellowish or greenish, with four upright petals; borne in more or less downy terminal panicles about 5-6 inches long and 2-3 inches broad. Panicles 4-6-flowered. Stamens project beyond yellow corolla.

FRUIT—Matures about October. A thick, round or pear-shaped, prickly capsule about 1 inch in dimeter, borne on a stout stalk, containing a single large, smooth, lustrous somewhat flattened brown nut. The falling fruit leaves a large scar on the twigs.

WOOD—Diffuse-porous; rays very fine, indistinct; pores very small, invisible to unaided eye, evenly distributed, mostly solitary; wood elements not in tier-like arrangement. Wood is weak, soft, whitish or sometimes pale yellow, lustrous. Weighs 28 lbs. per cubic foot. Used for paper-pulp, woodenware, artificial limbs, chip hats.

DISTINGUISHING CHARACTERISTICS—The Fetid Buckeye, also known as Ohio Buckeye, Stinking Buckeye, and American Horse-chestnut, can be distinguished by its leathery, dehiscent fruit containing one to three shining seeds. The fruit of this species is covered with spines while that of the Sweet Buckeye is smooth. The leaves are opposite and digitately compound with usually 5 or occasionally 7 leaflets. The buds are free from a resinous coating; the terminal one is often lacking. The flowers are showy, yellowish or greenish in color and arranged in large panicles borne at the ends of branches. The stamens project beyond the corolla while those of the Sweet Buckeye are just as long or shorter than the corolla. It is native only in the western part of the State.

RANGE—Western Pennsylvania, south to Alabama, west to Illinois, Iowa, and Oklahoma.

DISTRIBUTION IN PENNSYLVANIA—Found only in the extreme western part of the State Reported from Allegheny, Fayette, Lawrence, Mercer, Washington, Greene, and Westmoreland counties.

HABITAT—Usually found growing in moist soil. Prefers banks of streams, ravines, or similar situations.

IMPORTANCE OF THE SPECIES—The Fetid Buckeye is of no commercial importance in Pennsylvania. It is very limited in its distribution and usually remains small. It is occasionally planted as an ornamental tree, but is less popular than the Horse-chestnut.

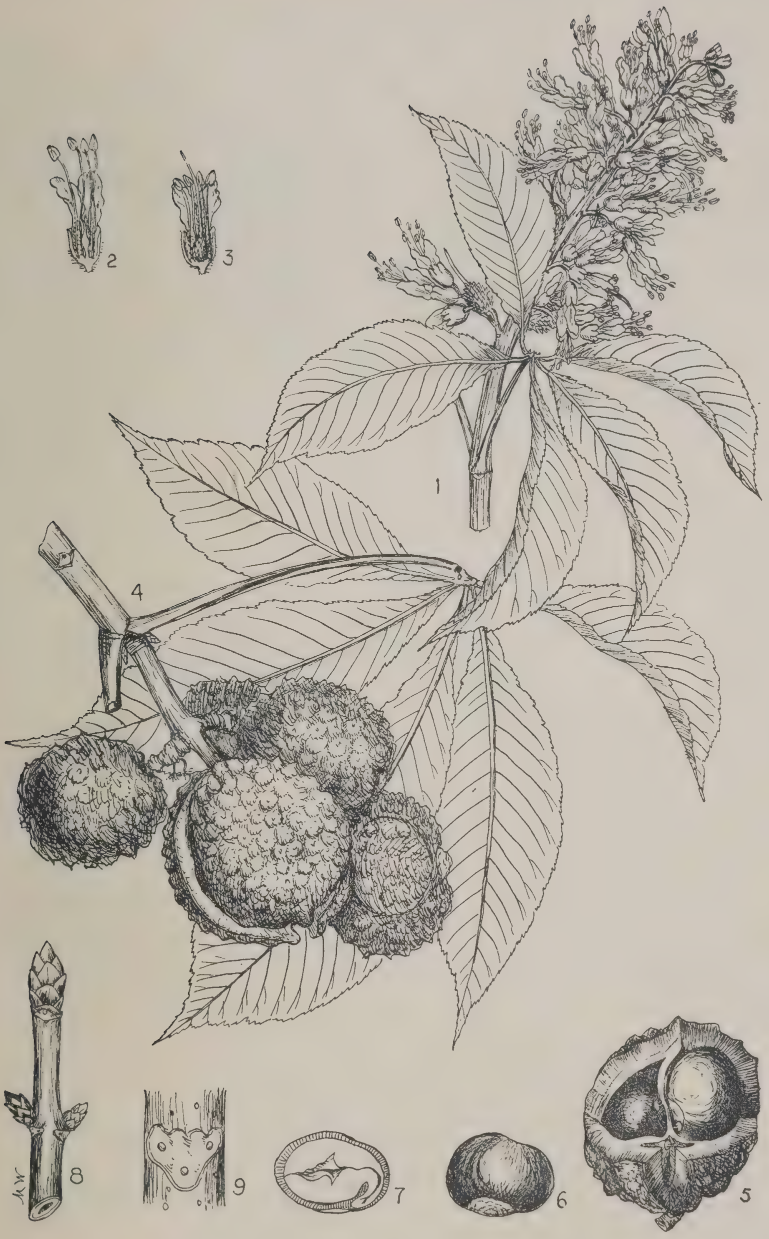

PLATE CXII. FETID BUCKEYE

1. A flowering branch, x $\frac{1}{2}$.
2. A flower with stigma below anthers, natural size.
3. A flower with stigma above anthers, natural size.
4. A fruiting branch, x $\frac{1}{2}$.
5. A fruit with part of shell removed showing two seeds, x $\frac{1}{2}$.
6. A seed, x $\frac{1}{2}$.
7. Longitudinal section of a seed, x $\frac{1}{2}$.
8. A winter twig, x $\frac{1}{2}$.
9. Section of a winter twig showing a leaf-scar with bundle-scars, natural size.

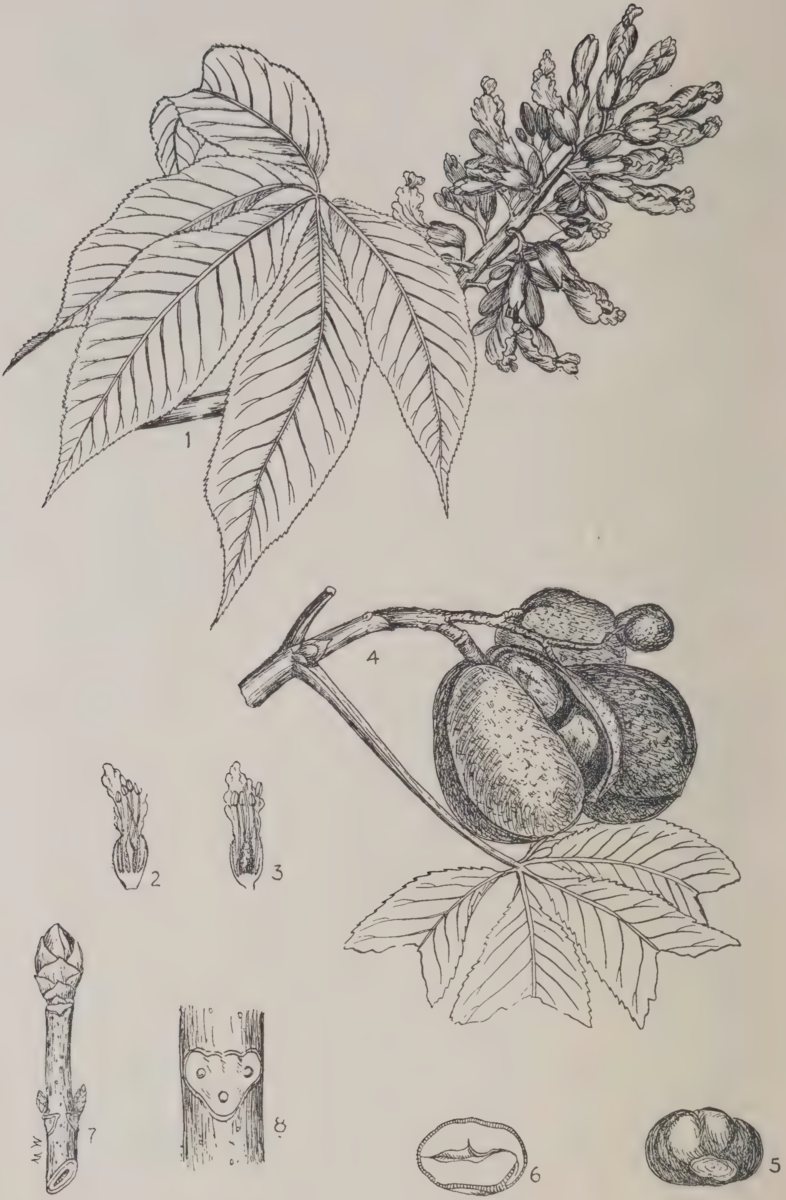

PLATE CXIII. SWEET BUCKEYE

1. A flowering branch, x ½.
2. A flower with stigma below anthers, natural size.
3. A flower with stigma above anthers, natural size.
4. A fruiting branch, x ½.
5. A seed, x ½.
6. Longitudinal section of a seed, x ½.
7. A winter twig, x ½.
8. Section of a winter twig showing a leaf-scar with bundle-scars, slightly enlarged.

SWEET BUCKEYE

Aesculus octandra, Marshall

FORM—The largest American species of the genus. Usually a small tree less than 60 ft. in height with a diameter of 18 inches, but may reach a height of 110 ft. with a diameter of over 3 feet. At its optimum in western North Carolina and eastern Tenessee. Reported a mere shrub in western Texas.

BARK—Light brown to grayish-brown, evidently-fissured, breaking up into many thin irregular scales. See Fig. 77.

TWIGS—Stout, at first finely hairy, becoming smooth, reddish-brown to ashy-gray, slightly ill-smelling when bruised. Pith large, light green, circular in outline.

BUDS—Opposite; terminal bud present and about 4/5-2 inches long; non-resinous, somewhat blunt-pointed, covered by nearly triangular or ovate keeled scales. Outer bud-scales reddish-brown, covered with a thin bluish bloom; inner bud-scales yellowish-green, enlarging in spring to 1-2 inches.

LEAVES—Opposite, compound, with 5, sometimes 7, short-stalked or stalkless leaflets. Leaflets oval to obovate, 4-10 inches long, finely toothed on margin, long-pointed at apex, narrowed at base, dark green and smooth on upper surface when mature, yellowish-green and somewhat hairy on under surface.

LEAF-SCARS—Opposite, large, heart-shaped to inversely-triangular. Bundle-scars large, usually arranged in 3 groups of 3 to 9 each.

FLOWERS—Appear about April or May when the leaves are developed. Small, yellow or purplish, with 4 conniving petals; borne in finely hairy terminal panicles about 4-12 inches long. Stamens are included in yellow corolla.

FRUIT—Matures about October. A smooth obovoid capsule, about 1-2 inches thick. Seeds several, large, smooth, reddish-brown, lustrous, ¾-1½ inches broad, somewhat flattened. Valves of capsule thin, pale brown, not spiny or warty. The fruit is poisonous to stock, but seldom proves fatal.

WOOD—Similar to that of the Fetid Buckeye, page 206, but it is somewhat lighter in weight and has the wood elements in a tier-like arrangement. Used for lumber, veneer, slack cooperage, paper-pulp, candy boxes, dishes, bowls, and artificial limbs.

DISTINGUISHING CHARACTERISTICS—The Sweet Buckeye, also known as Yellow Buckeye and Big Buckeye, is native only to the extreme western part of the State. The leaves are opposite, digitately compound with usually 5 or sometimes 7 leaflets. The flowers are showy, yellowish in color, and arranged in large panicles borne at the ends of branches. The stamens are usually included in the corolla while those of the Fetid Buckeye project beyond it. The valves of the fruit-capsule are smooth. The twigs are stout, contain a large pith and are roughened by large conspicuous bundle-scars. The buds are large and non-resinous. The twigs when bruised are less ill-smelling than those of the Fetid Buckeye. It is the largest American species of the genus.

RANGE—Western Pennsylvania to Illinois, Iowa, and Oklahoma, south to Georgia and Texas.

DISTRIBUTION IN PENNSYLVANIA—Occurs only in the extreme western part of the State. Found in Allegheny, Greene, and Fayette counties. Very abundant along Dunkard Creek, in the southern part of Greene county.

HABITAT—Usually grows in mixture with hardwoods in rich soil. Prefers rich bottomlands and valleys. Common along or near streams.

IMPORTANCE OF THE SPECIES—The Sweet Buckeye is of no commercial importance in Pennsylvania. It is very limited in its distribution in the State. The wood which it produces and the small size which it attains in the northern part of its range do not justify its planting for forestry purposes. It is, however, the largest American representative of the genus. It grows rapidly and may be planted for ornamental purposes.

BASSWOOD

Tilia americana, Linnaeus

FAMILY AND GENUS DESCRIPTION—The Linden family, Tiliaceae, comprises about 35 genera with probably 375 species found in temperate and tropical regions. The members consist of trees, shrubs, and a few herbs. One genus, Tilia, alone has tree representatives in North America. This genus comprises about 20 species, 8 of which are native to North America and three to Pennsylvania. Two species are described here. The third species, known as Michaux's Basswood (Tilia Michauxii Nutt.) is very rare in this State. Its leaves which are densely pubescent and grayish-green beneath and its floral bracts usually rounded at the base are distinctive. The bark of the branches is usually smoother and lighter than that of the 2 other native species.

FORM—A large tree usually attaining a height of 60-70 ft. but may reach a height of 120 ft. with a diameter of 4½ feet. Trunk straight, clean, with little taper. Crown dense, broad, rather deep, ovoid or rounded.

BARK—On old trunks firm but easily cut, thick, longitudinally-furrowed into flat scaly ridges. Ridges often divided by transverse secondary furrows. On young stems dark gray and smooth. See Fig. 98.

TWIGS—Smooth or very finely hairy, shining, bright red; second year olive, olive-red, or covered with a gray skin; usually zigzag, tough, mucilaginous if chewed, covered with scattered, dark, oblong lenticels. In cross-section, characteristic blunt conical masses with intervening lighter colored areas are present.

BUDS—Alternate; terminal bud absent; ovoid, 2-ranked, stout, often somewhat flattened, divergent, usually deep red, occasionally greenish, mucilaginous, smooth or sometimes slightly hairy toward apex. Bud-scales glabrous, thick, rounded at back, usually 3 visible; one large scale makes bud unsymmetrical.

LEAVES—Alternate, simple ovate to orbicular, 4-7 inches long, firm in texture, long-pointed at apex, deeply toothed on margin with sharp teeth, unequally heart-shaped to truncate at base, dark green and shining on upper surface, green and smooth on lower except for a few runty hairs. Leaf-stalks slender, ⅓ length of blade. The side of the leaf nearest the branch is the largest.

LEAF-SCARS—Alternate, large, conspicuous, raised, 2-ranked, containing few to many bundle-scars arranged in a ring or a single curved line, or scattered. Stipule-scars distinct, one narrow, the other broad; often show bundle-scars.

FLOWERS—Appear about June. Perfect, regular, sweet, fragrant, yellowish-white, 5-20 in drooping cymose clusters. The long peduncle which bears the flowers is united for about half its length with a conspicuous green bract.

FRUIT—A woody, spherical, nut-like drupe about the size of a pea. Occurs singly or in small clusters with a common stalk attached to a leafy bract and often persisting far into winter.

WOOD—Diffuse-porous; rays distinct, but colorless; light, soft, compact, moderately strong, light brown to nearly white, fine in texture; little difference between spring wood and summer wood. Weighs 28 lbs. per cubic foot. Used in the manufacture of paper-pulp, woodenware, cheap furniture, panels for carriages, kegs, pails, barrel headings, berry boxes.

DISTINGUISHING CHARACTERISTICS—The Basswood, also known as Linden, Lime-tree, Whitewood, Beetree, Whistle-wood, and Lynn, may be distinguished by its large, firm unequally based leaves with green and smooth lower surfaces, by its smooth bright red twigs, by its alternate, deep red, unsymmetrical buds with 2-3 visible scales, by its white flowers arranged in drooping clusters attached to a green bract, and by its woody spherical nut-like drupe about the size of a pea attached to winged bracts. The dark funnel-shaped areas in the inner bark alternating with lighter areas as seen in a cross-section of a twig are characteristic. The smooth dark gray bark of younger stems and the thick longitudinally-furrowed bark on older trunks are distinguishing features.

RANGE—New Brunswick to Manitoba, southward to Georgia and eastern Texas.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southeastern parts of the State. Rare in the mountainous parts except in rich valleys. Locally abundant in the western and southern parts.

HABITAT—Rarely grows in pure stands, but usually mixed with other hardwoods. Prefers rich soils in bottomlands. It can endure considerable shade. It suffers little from windfall but occasionally from windbreak upon exposed situations.

IMPORTANCE OF THE SPECIES—Basswood is one of our important timber trees on account of the valuable wood and the bark which it produces. Seeds or seedlings may be planted. If seedlings are used, they should be planted early in spring before growth starts. The tree sprouts from stump very freely (Fig. 98). It grows rapidly, produces beautiful sweet-smelling flowers, and is rarely attacked by fungi. It is one of our most attractive ornamental trees.

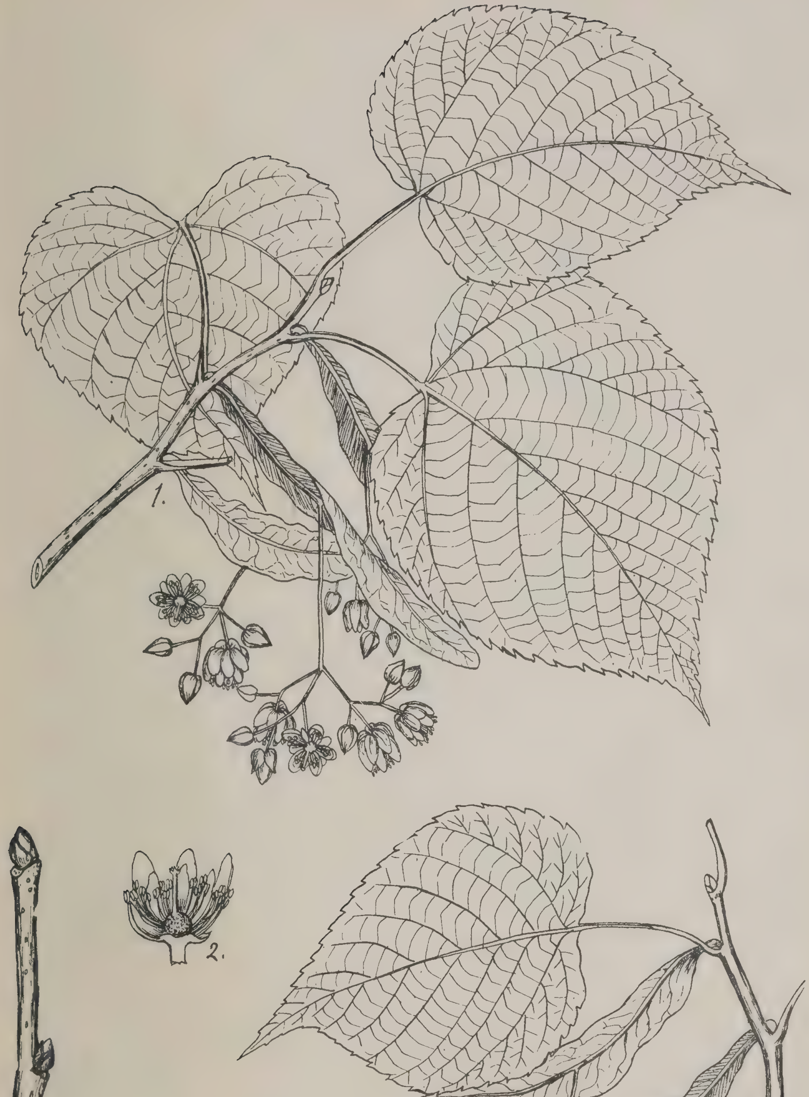

PLATE CXIV. BASSWOOD

1. A flowering ranch with mature leaves, x ½.
2. Longitudinal section of a flower, slightly enlarged.
3. A fruiting ranch, x ½.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.
6. A leaf-scar with bundle scars, enlarged.

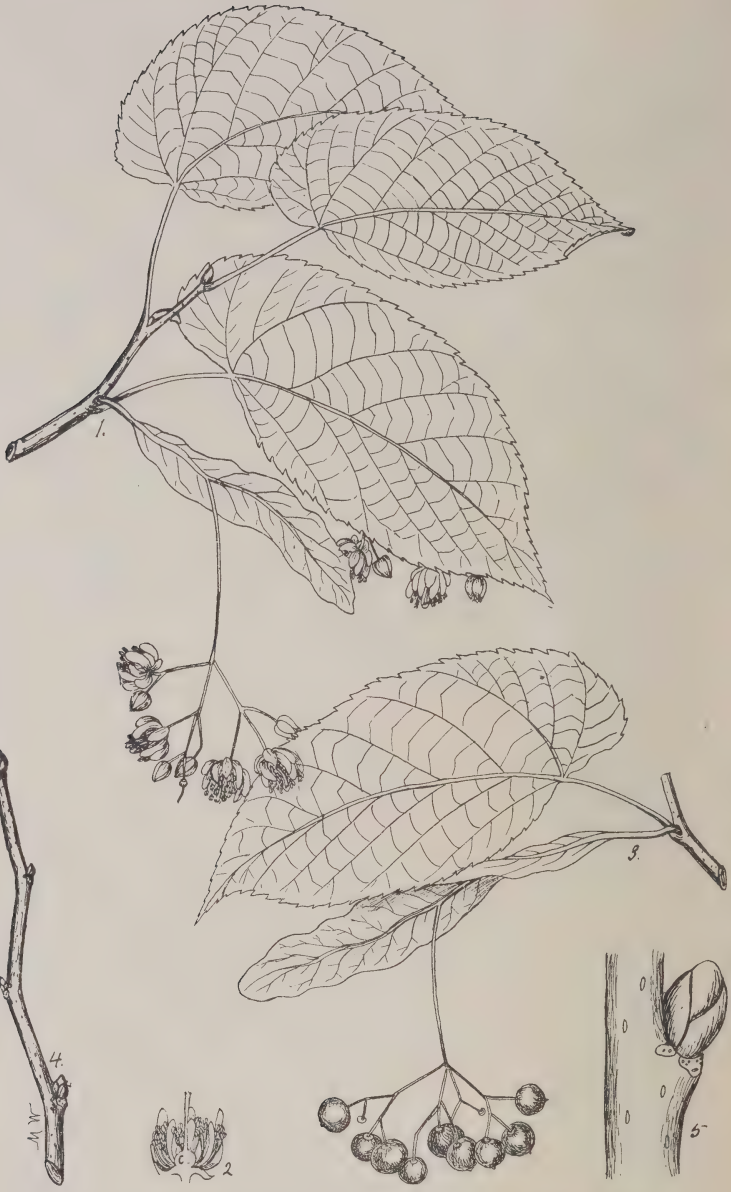

PLATE CXV. WHITE BASSWOOD

1. A flowering branch with mature leaves, x ½.
2. Longitudinal section of a flower, slightly enlarged
3. A fruiting branch x ½.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.

WHITE BASSWOOD

Tilia heterophylla, Ventenat

FORM—Usually 50-60 ft. high but may reach a height of 90 ft. with a diameter of 4½ feet. It becomes as thick but not so high as the common Basswood. Trunk straight, clean, slightly tapering. Crown dense, broad, rather rounded.

BARK—Similar to that of the common Basswood, page 208.

TWIGS—Similar to those of the common Basswood, page 208.

BUDS—Similar to those of the common Basswood, page 208.

LEAVES—Alternate, simple, variable in outline, oblong-ovate to orbicular-ovate, 5-8 inches long, firm in texture, short taper-pointed at apex, deeply toothed on margin with sharp teeth, unequally heart-shaped to truncate at base; upper surface dark green and smooth, lower surface silvery-white and finely hairy. Leaf-stalk slender, ½ length of blade. The side of the leaf nearest the branch is the largest.

LEAF-SCARS—Similar to those of the common Basswood, page 208.

FLOWERS—Appear about June or July. Perfect, regular, sweet, fragrant, yellowish-white, 5-15 drooping cymose clusters. The long peduncle which bears the flowers is united for about half its length with a conspicuous green bract.

FRUIT—A woody, spherical, nut-like drupe about the size of a pea. Occurs singly or in small clusters with a common stalk attached to a leafy bract and often persists far into winter.

WOOD—Similar to that of the common Basswood, page 208, only about 2 pounds lighter.

DISTINGUISHING CHARACTERISTICS—The White Basswood, also known as White Linden, has the general characteristics of the common Basswood, page 208. It can be distinguished from the latter by its leaves which are slightly larger, silvery-white and finely hairy on the lower surface, while those of the Basswood are green and smooth. The common Basswood also reaches a somewhat larger size and has a wider distribution in this State, than the White Basswood.

RANGE—New York to Florida, westward to Illinois, Tennessee, and Alabama.

DISTRIBUTION IN PENNSYLVANIA—Occurs locally in the mountainous parts, and a few additional outposts. Found in Franklin, Huntingdon, Susquehanna, and Washington counties.

HABITAT—Usually found in rich woods in mountainous regions. Tolerates dense shade, but thrives in full light. Occurs in mixture with other hardwoods. Common on limestone soil.

IMPORTANCE OF THE SPECIES—White Basswood is of little commercial importance in this State on account of its limited distribution. Farther south it is more abundant, being the prevailing Basswood of West Virginia. It is one of our most attractive ornamental trees.

FLOWERING DOGWOOD

Cornus florida, Linnaeus

FAMILY AND GENUS DESCRIPTION—The Dogwood family, Cornaceae, comprises about 15 genera found mostly in temperate regions. Only 2 genera are native to North America, both of which have representatives in this State. They are the Dogwoods (Cornus) and the Gums (Nyssa). The genus Cornus is widely distributed in temperate regions and comprises about 40 species of which number 15 are native to North America and 8 to Pennsylvania. A few species reach tree-size and yield a very hard and valuable wood.

FORM—A small tree usually from 15-25 ft. high but may reach a height of 40 ft. with a diameter of 18 inches. Trunk with little taper up to the first branches and then practically disappears entirely in the branches. Crown broad, high, and rather dense.

BARK—On younger stems and branches light brown to reddish-gray and rather smooth. On older stems reddish-brown to black, broken up into quadrangular scaly blocks. Bark rather bitter and ill-smelling. See Fig. 122.

TWIGS—Usually red, sometimes tinged with green, smooth, glossy, often covered with a glaucous bloom; lenticels few and small; pith white and gritty.

BUDS—Opposite; terminal bud present. Flower-buds terminal, spherical, 1/5-2/5 of an inch broad, covered by two opposite pairs of bud-scales. Lateral buds small often covered by persistent bases of leaf-stalks. Terminal leaf-buds reddish, slightly downy, covered by 2 gaping bud-scales.

LEAVES—Opposite, simple, clustered towards end of branches, ovate, 3-5 inches long, 2-3 inches wide, acute at apex, wedge-shaped at base, entire to wavy on margin, bright dark green above, pale below. Midrib and primary veins prominent.

LEAF-SCARS—Opposite, may or may not encircle stem; bundle-scars 3 and occasionally more. Evidently-raised on the base of leaf-stalks on seasons' growth, and forming a deep V-shaped notch between them.

FLOWERS—Appear about April. Perfect, greenish, arranged in dense heads, and surrounded by a large white involucre which is often mistaken for the corolla.

FRUIT—Ripens about October. A scarlet ovoid drupe about 3/5 of an inch long, containing a grooved stone, borne solitary or in clusters of 2-5 on a stalk. Undeveloped pistillate flowers often persist about base of fruit.

WOOD—Diffuse-porous; medullary rays distinct; light red or pink in color. Wood very heavy, hard, strong, tough, pale reddish-brown to pinkish, with lighter colored sapwood. Weighs 51 lbs. per cubic foot. Used for shuttles, golf stick heads, brush blocks, wedges, engravers' blocks, tool handles, and many kinds of turnery.

DISTINGUISHING CHARACTERISTICS—The Flowering Dogwood, also known as Boxwood, Dogwood and Flowering Cornel, can be distinguished by its opposite branching, bright red or occasionally greenish twigs, small lateral buds covered by the persistent bases of the leaf-stalks, large spherical flower-buds, terminal leaf-buds with a single pair of bud-scales, and by its alligator bark. In autumn the fruit, and in spring the flowers, also aid in distinguishing it.

RANGE—Massachusetts west through Ontario to Michigan and Missouri and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State; most common in the eastern and southern parts.

HABITAT—Prefers well-drained soil but will grow on most of our soils. Generally prevalent but most common and thrives best in low, moist, and rather fertile situations. Usually found in the understory of the forest.

IMPORTANCE OF THE SPECIES—The Flowering Dogwood is valuable for ornamental purposes and for its wood. Few trees surpass it in beauty when in bloom and when fruiting. In this State it does not reach a sufficient size to be of commercial importance. It should be maintained in our forest on account of its beauty and its value as a soil improver, since it is very tolerant and will grow readily in the understory of the forest.

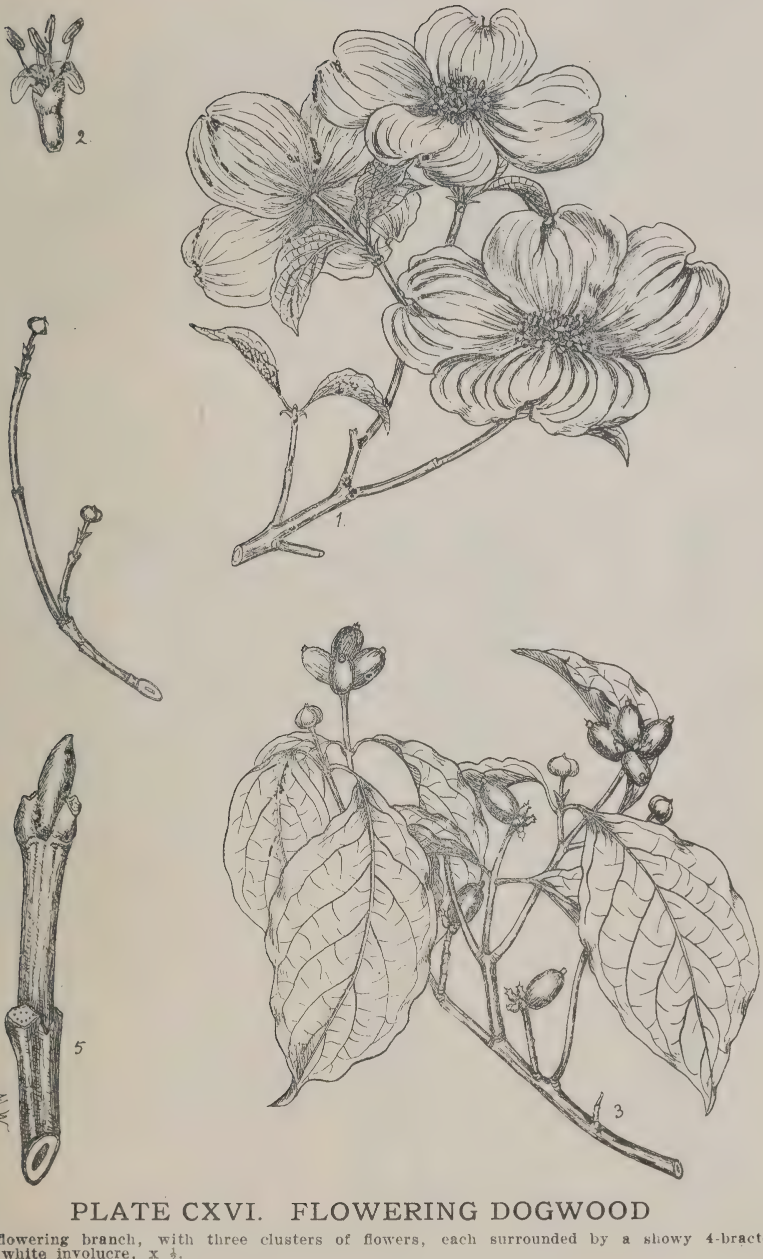

PLATE CXVI. FLOWERING DOGWOOD

1. A flowering branch, with three clusters of flowers, each surrounded by a showy 4-bracted white involucre, x ½.
2. A single flower, enlarged.
3. A fruiting branch with mature leaves, x ½.
4. A winter twig with two terminal spherical flower buds, x ½.
5. Terminal section of a winter twig showing leaf-scars and leaf-buds, enlarged.

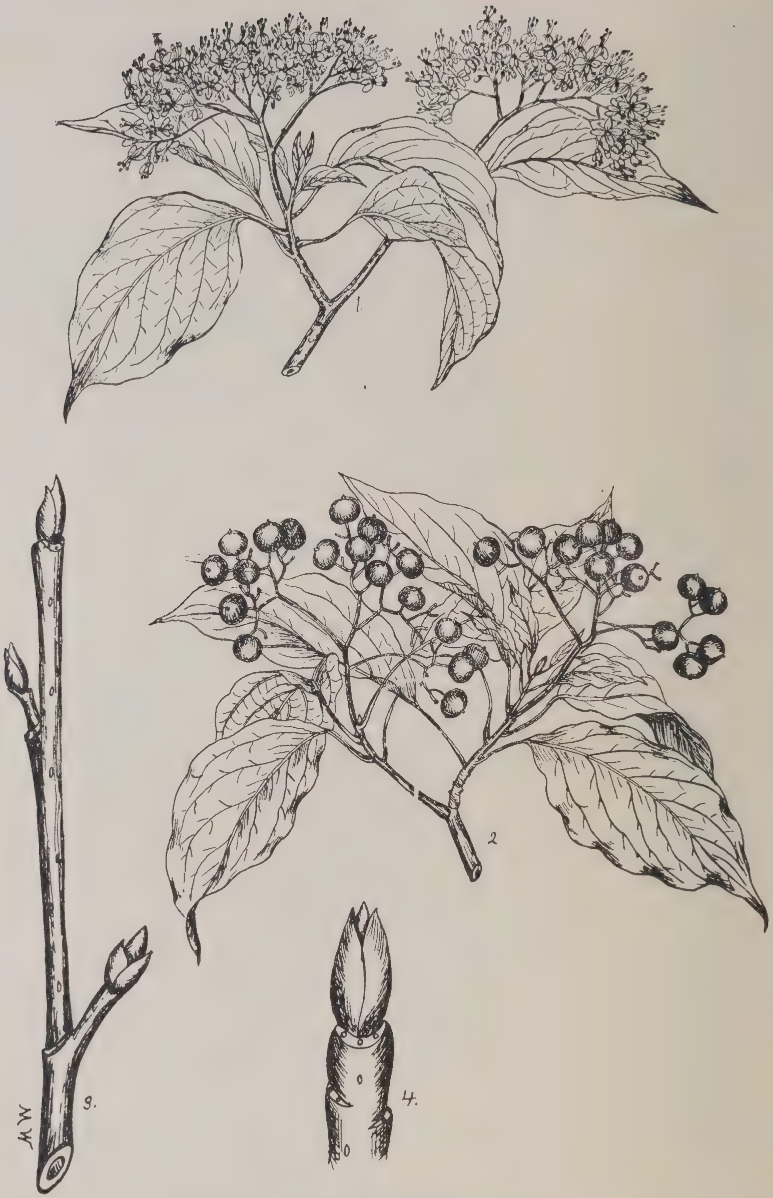

PLATE CXVII. ALTERNATE-LEAVED DOGWOOD

1. A flowering branch, x ½.
2. A fruiting branch, x ½.
3. A winter twig, natural size.
4. Terminal section of a winter twig, enlarged.

ALTERNATE-LEAVED DOGWOOD

Cornus alternifolia, Linnaeus

FORM—A small tree usually about 10-20 ft. high but may reach a height of 30 ft. with a diameter of 8 inches. Trunk is short. Crown broad, deep, flat-topped, and dense.

BARK—Rather thin; on younger stems greenish streaked with white, and smooth; on older stems reddish-brown and roughened by shallow longitudinal fissures which are sometimes joined transversely.

TWIGS—Alternate, rather slender and flexible, smooth, often glossy, at first reddish-green, later dark green and often striped with white; bitter to the taste and emitting an offensive smell if punctured; marked with leaf-scars and scattered lenticels.

BUDS—Alternate, rarely opposite, oval, sharp-pointed, covered with a few, usually 2-3, chestnut-brown scales. Outer scales are often separated towards apex.

LEAVES—Alternate, sometimes opposite, simple, frequently clustered at end of branches, 3-5 inches long, 2-3 inches wide, ovate, acuminate at apex, wedge-shaped at base, entire or wavy on margin, bright green above, usually almost white downy below.

LEAF-SCARS—Alternate, sometimes opposite, situated on extensions of the twigs, with their surfaces often at right angles to twigs; in outline resemble the moon in first quarter and contain 3 bundle-scars.

FLOWERS—Appear about April. Cream-colored, perfect, borne in many-flowered terminal cymes.

FRUIT—A dark blue spherical drupe, $\frac{1}{3}$ of an inch in diameter, tipped with remnants of the style, borne in cymes. Ripens in October.

WOOD—About the same as the flowering dogwood, but no uses of it are reported.

DISTINGUISHING CHARACTERISTICS—The Alternate-leaved Dogwood, also known as Blue Dogwood, Purple Dogwood, Green Osier, and Pigeon-berry, may be designated by its alternate branching, reddish-green to dark green twigs, cream-colored flowers and dark blue fruit arranged in cymes. It does not have the alligator bark of the Flowering Dogwood and usually frequents moister habitats.

RANGE—Nova Scotia to Alabama, and westward to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Throughout the State. Common in the portions which are well watered.

HABITAT—Prefers moist well-drained soil. Most common along streams and other bodies of water and borders of woodlands. Very tolerant of shade.

IMPORTANCE OF THE SPECIES—The Alternate-leaved Dogwood is of little commercial importance. It is very pretty and may be of value as a soil-conserver.

BLACK GUM

Nyssa sylvatica, Marshall

GENUS DESCRIPTION—The genus Nyssa is rather limited in its distribution, being confined to the eastern United States and southern Asia. It comprises 7 species in the world, 5 of which are native to North America and 1 to Pennsylvania. All the representatives produce wood which is very tough on account of its twisted and contorted grain.

FORM—Usually a medium-sized tree with a height of 15-40 ft., but may reach a height of 100 ft. with a diameter of 5 feet. Trunk straight and rather continuous. Many lateral branches are horizontal; some of the lower are drooping and the upper ascending. Old trees often have a low flat crown but have their middle and lower trunk covered with small horizontal branches.

BARK—Grayish, smooth to scaly on young trunks; reddish-brown to grayish-black, very rough and scaly on older trunks. Forms what is known as alligator bark on very old trunks characterized by quadrangular and hexagonal blocks. See Fig. 119.

TWIGS—Smooth, with few lenticels, grayish to reddish-brown; pith rather large, white, separated by layers of stone cells which may be seen with magnifying glass.

BUDS—Alternate, ovate, reddish-brown, ¼ of an inch long, usually smooth, covered by 3-5 visible, ovate, closely overlapping scales. Lateral buds sometimes superposed, smaller than terminal one. Buds originate close to leaf-scars and occasionally protrude into them.

LEAVES—Alternate, simple, oval, 2-5 inches long, acute at apex, wedge-shaped at base, entire and slightly thickened on margin, dark green and shiny above, often hairy below, turning to a gorgeous red in fall.

LEAF-SCARS—Alternate, conspicuous, rather large, broadly crescent-shaped, with three single or 3 groups of bundle-scars, which are conspicuous on account of size; brownish in color, contrasting with lighter surface of the leaf-scar.

FLOWERS—Appear in May or June. Borne on long slender somewhat downy stalks. Staminate and pistillate flowers separate. Staminate occurs in dense many-flowered heads; pistillate in open few-flowered clusters.

FRUIT—A small dark blue, fleshy berry or drupe, ovoid, ⅜ of an inch long, 1-3 in a cluster, often with a few remnants of undeveloped pistillate flowers at base. Borne on long stalks. Ripens in October.

WOOD—Diffuse-porous; rays indistinct; growth-rings usually indistinct; pores numerous, small, uniform in size and distribution; wood cross-grained, tough to split, difficult to work, not hard, moderately strong and stiff, not durable, light yellow. Weighs 37 lbs. per cubic foot. Used for hubs of wheels, boxes, ironing boards, rolling pins, chopping bowls, excelsior, broom handles, baskets, and berry crates.

DISTINGUISHING CHARACTERISTICS—The Black Gum, also known as Sour Gum, Tupelo, and Pepperidge, can be distinguished by its alligator bark when old, grayish to reddish-brown smooth clear twigs when young, which are marked with conspicuous leaf-scars with three bundle-scars. The buds diverge very much from the twigs and may be superposed. Lateral branches on young trees often take a horizontal position. The separation of the pith by stone sells, the gorgeous red color of the autumnal foliage, and the bluish berries also aid in recognizing it.

RANGE—Maine to Tampa Bay, Florida; west to southern Ontario and Michigan, southward to Texas.

DISTRIBUTION IN PENNSYLVANIA—Very common in the eastern, central, and southern parts, local in western part, rarer in northern part. Reaches large size in swamps of Adams, Mifflin, and Franklin counties.

HABITAT—Found in variable habitats. Very common on burnt-over areas, on dry mountain slopes, abandoned fields, abandoned charcoal hearths; but reaches its best development along streams and in low wet situations. While it has preferences, it is not a chooser of habitats.

IMPORTANCE OF THE SPECIES—The Black Gum has been despised since the early farmers tried to split it for fence rails. It is slowly gaining favor, but is not of sufficient importance to be recommended for forest planting. Its autumnal foliage is beautiful and in winter the form of young trees is very attractive.

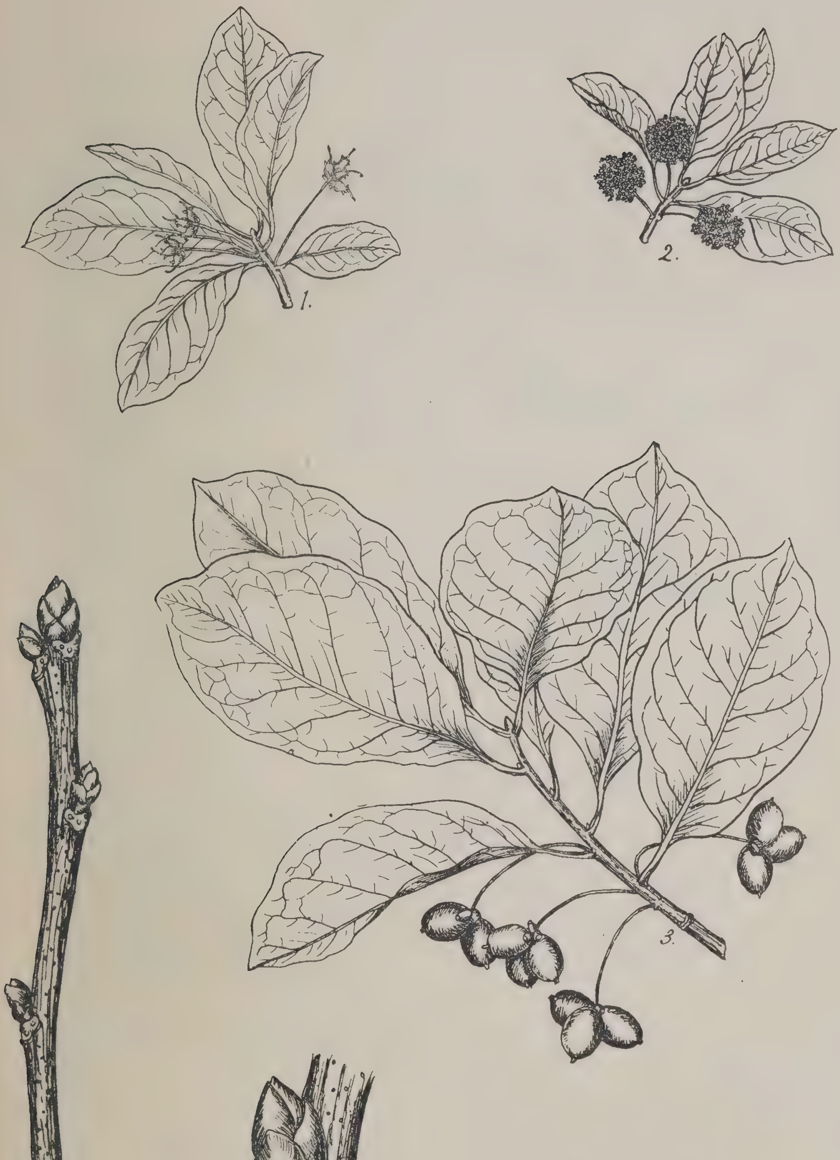

PLATE CXVIII. BLACK GUM

1. A pistillate flowering branch, x ½.
2. A staminate flowering branch, x ½.
3. A fruiting branch with mature leaves, x ½.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

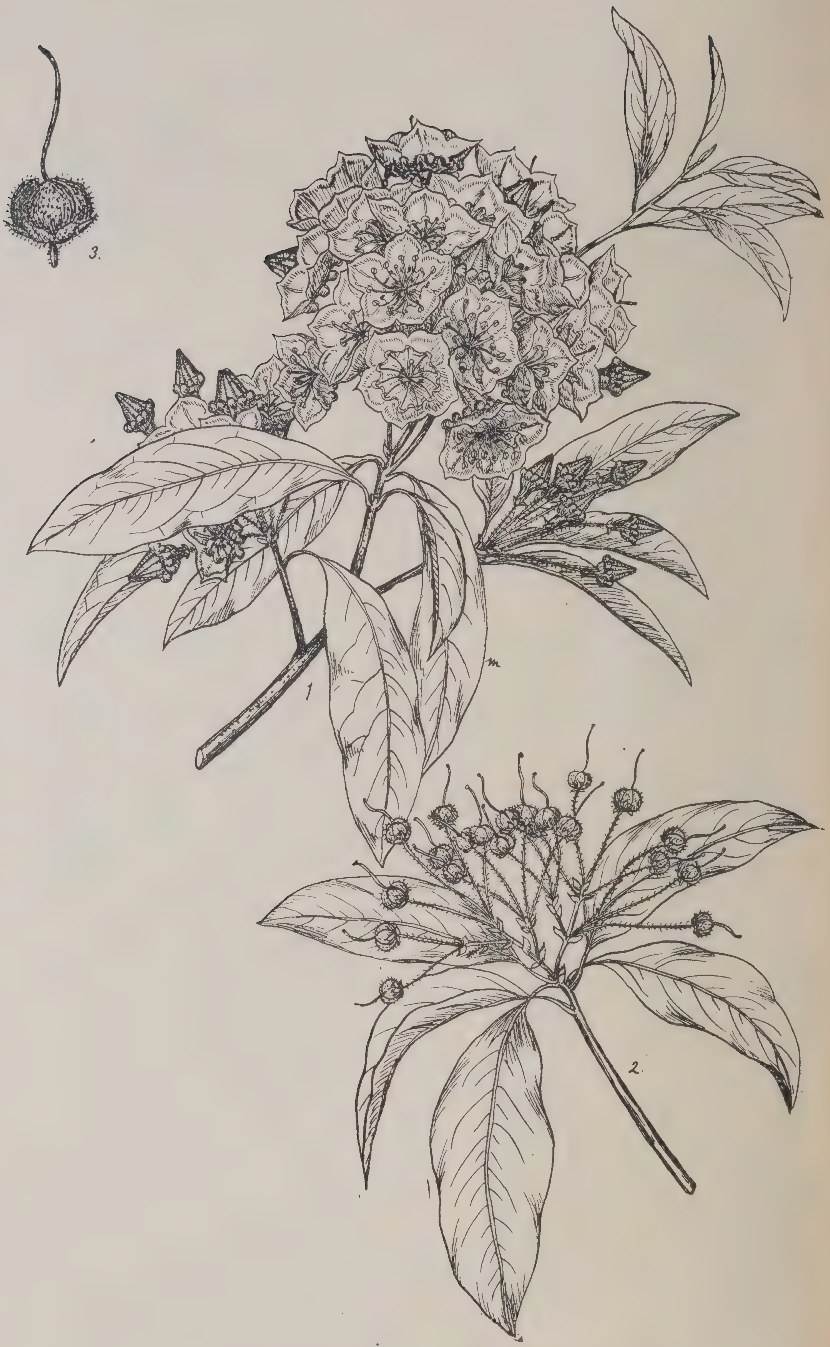

PLATE CXIX. MOUNTAIN LAUREL

1. Flowering branch with (i) immature leaves, (m) mature leaves, and with open and closed blossoms, x ½.
2. Branch with mature leaves and mature fruit, x ½.
3. A fruit, enlarged.

MOUNTAIN LAUREL

Kalmia latifolia, Linnaeus

FAMILY AND GENUS DESCRIPTION—The Heath family, Ericaceae, embraces species which are amongst our best known and most popular shrubs. The Huckleberries, Blueberries, Cranberries, Azaleas, Kalmias, and Rhododendrons are some of the commonest representatives. Very few representatives are of any special economic value on account of the wood which they produce. Some are important on account of their aesthetic value, while others yield valuable food or are used in medicine. This family comprises about 90 genera with more than 1,400 species, of which number about 40 genera are found in the United States, 7 of which have tree representatives. The flora of Pennsylvania comprises 27 genera with about 45 species. Since most of them are shrubs only 3 species representing 3 genera are described here. The genera here described are Kalmia, Rhododendron, and Oxydendrum.

The genus Kalmia comprises 5 or 6 species in North America and Cuba. The species described on this page is the only one which reaches tree-size. Two other shrub species, Sheep Laurel (Kalmia angustifolia L.) and Swamp Laurel (Kalmia polifolia Wang.), are also native to this State. The genus is named after Peter Kalm, a Swedish naturalist, who traveled in North America during the middle of the 18th century.

FORM—In Pennsylvania usually a shrub 5-10 ft. in height with a stout stem which is usually forked, often inclined and bearing divergent branches which form a round compact head. In the South it reaches a height of 30-40 ft. with a diameter of 20 inches.

BARK—Very thin, reddish-brown, furrowed, peels off into long, narrow, thin scales exposing cinnamon-red inner bark.

TWIGS—At first reddish-green covered with viscid hairs, later becoming decidedly green, and finally brown. Rather smooth except where roughened by leaf-scars and bud-scale scars.

BUDS—Alternate, ovate, sharp-pointed, greenish in color. Leaf-buds are formed early and appear below the clustered flower-buds. Flower-buds are covered by numerous, downy and overlapping green scales which are coated with glandular hairs and enlarge with the developing shoot in spring.

LEAVES—Alternate, sometimes paired, simple, oblong, wedge-shaped at base, entire-margined, acute at apex sometimes tipped with bristle point, 3-4 inches long, about ½ of an inch wide. Mature leaves are thick, leathery, dark green, glossy above, yellowish-green below, and persist for two seasons.

LEAF-SCARS—Large, imbedded in twig, with a cluster of bundle-scars.

FLOWERS—Emerge from flower buds which begin to expand in early spring and open about May or June. Flowers are borne in red or green scurfy stalks and arranged in dense many-flowered corymbs which have a diameter of about 4 inches. Calyx is divided into five parts. Corolla is white to rose-colored and viscid pubescent.

FRUIT—Matures about September. It is a many-seeded woody capsule, roundish in outline but slightly five-lobed and covered with viscid hairs. Both style and calyx persist. Each capsule produces many seeds.

WOOD—Diffuse-porous; heavy, hard, strong, rather brittle. Heartwood reddish-brown, sapwood lighter colored. Weighs 45 lbs. per cubic foot. Where it grows to a fair size it is an excellent wood for fuel. It is also used in manufacture of tool handles, penholders, bucket handles, turnery, and tobacco pipes. About 85,000 lbs. of this wood are produced annually in North Carolina for pipes.

DISTINGUISHING CHARACTERISTICS—The Mountain Laurel, also known as Kalmia and Calico Bush, is one of our few broad-leaved species whose leaves persist over winter. It can be distinguished from all other species native to this State by its thick leathery leaves which are 3-4 inches long, persistent, decidedly glossy on upper surface and yellowish-green on lower surface. The Great Laurel or Rhododendron is also evergreen but its leaves and buds are much larger than those of the Mountain Laurel. The leaves of the Mountain Laurel are shorter, narrower, and sharper-pointed than those of the Rhododendron.

RANGE—New Brunswick south generally along the mountains to Florida west to Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Throughout the State. Most common in the mountainous parts, where it often forms almost impenetrable thickets. Very rare and local, or absent, in the extreme western part.

HABITAT—Common along margins of swamps and as an understory in deciduous forests. Also found on hillsides and hilltops. Very common on rocky hilltops.

IMPORTANCE OF THE SPECIES—The Mountain Laurel remains too small in this State to be of commercial importance on account of the wood which it produces. Next to Rhododendron, it is the most attractive native shrub found in our flora. It is a favorite with lovers of the woods who admire not only its blossoms, but also its leaves and its habit of growth.

GREAT LAUREL

Rhododendron maximum, Linnaeus

GENUS DESCRIPTION—The name Rhododendron is of Greek origin and meanes Rose tree. It comprises about 100 species of shrubs and a few small trees in the northern hemisphere. About 10 species are native to North America and 1 to Pennsylvania.

FORM—A shrub or small bushy tree. In this State usually a shrub from 5-12 ft. in height, but in the montains of the South it may reach a height of 35 feet. Stems often twisted, bearing contorted branches which form an irregular round head.

BARK—Thin, reddish-brown, at first close, later peeling off into thin scales.

TWIGS—At first green and coated with rusty pubescence but become smooth during first winter, and gradually turn to bright red-brown.

BUDS—Alternate; leaf-buds and flower-buds distinct. Leaf-buds usually axillary, sometimes terminal, dark green, cone-shaped, form in midsummer. Flower-buds usually terminal, cone-shape, 1-1½ inches long, covered by numerous, overlapping, green bracts.

LEAVES—Alternate, simple, persistent, clustered at apex of branches, ovate to oblong, acute at apex, rounded to wedge-shaped at base, entire on margin, 4-11 inches long, 1½-2½ inches wide, thick, leathery, smooth and dark green on upper surface, whitish on lower surface.

LEAF-SCARS—Alternate, slightly raised, conspicuous, rounded at base, slightly depressed at top, with several bundle-scars arranged in a U-shaped line.

FLOWERS—Appear about June after the new leaves are fully developed, are arranged in umbel-like clusters about 4-5 inches in diameter, and borne on glandular pedicels. Individual flowers are perfect, pale rose to white in color; upper petals marked by yellowish-green dots.

FRUIT—A dark reddish-brown capsule about ½ of an inch long, which persists until the following season. Capsules split open lengthwise liberating oblong flattened seeds. Surrounded at the base by persistent calyx and terminated by persistent linear style.

WOOD—Diffuse-porous; hard, strong, brittle, light brown with lighter sapwood. Weighs 39 lbs. per cubic foot. Of little commercial use but occasionally manufactured into tool handles and engraving blocks. Excellent for fuel where it reaches a fair size.

DISTINGUISHING CHARACTERISTICS—The Great Laurel, also known as Rhododendron and Rose Bay, can be distinguished from all other species of trees native to Pennsylvania by its large, persistent, leathery, simple leaves which are clustered towards the end of the branches and alternate in their arrangement. Its shrubby form and its preference for moist habitats also aid in distinguishing it. The conical flower-buds, which are usually terminal and often over an inch long, are also characteristic. The twigs are evidently marked by the bud-scale scars.

RANGE—Nova Scotia and Lake Erie on the north, south along the mountains to northern Georgia.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State. Rare in the southeastern and western parts. Abundant throughout the mountainous parts.

HABITAT—In the North frequents a cold swampy situation. In the South it ascends the mountains to 5,000 feet but remains along the banks of streams. Tolerates most soils except limestone.

IMPORTANCE OF THE SPECIES—The Rhododendron does not reach a large enough size in Pennsylvania to produce wood of commercial importance. In the South it often becomes a tree. It is the most attractive shrub in our flora, and will thrive in a variety of situations but prefers moist locations and flees from soils which contain lime.

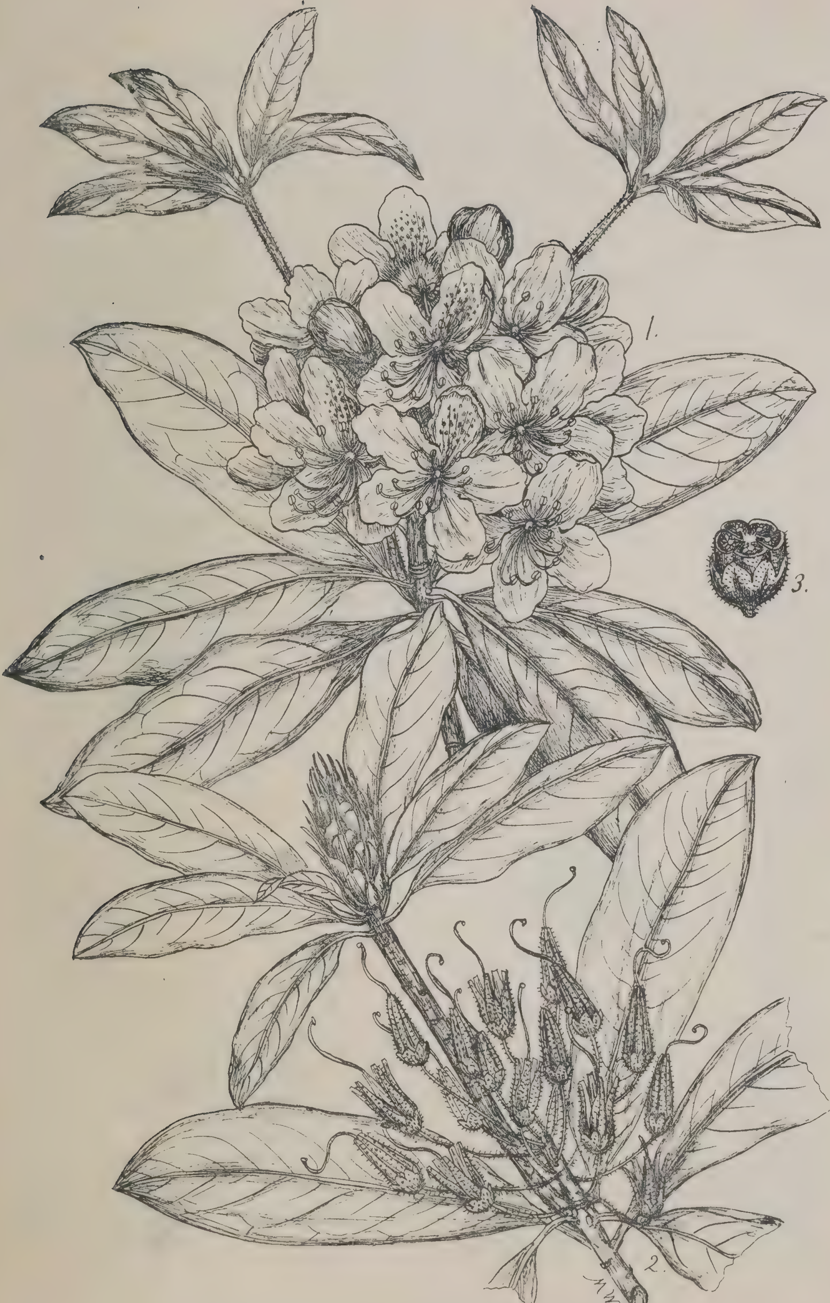

PLATE CXX. GREAT LAUREL

1. Branch with mature and immature leaves, and a cluster of open flowers, x ½.
2. A fruiting branch with a large terminal bud, x ½.
3. Cross-section of a fruit capsule showing five cells, natural size.

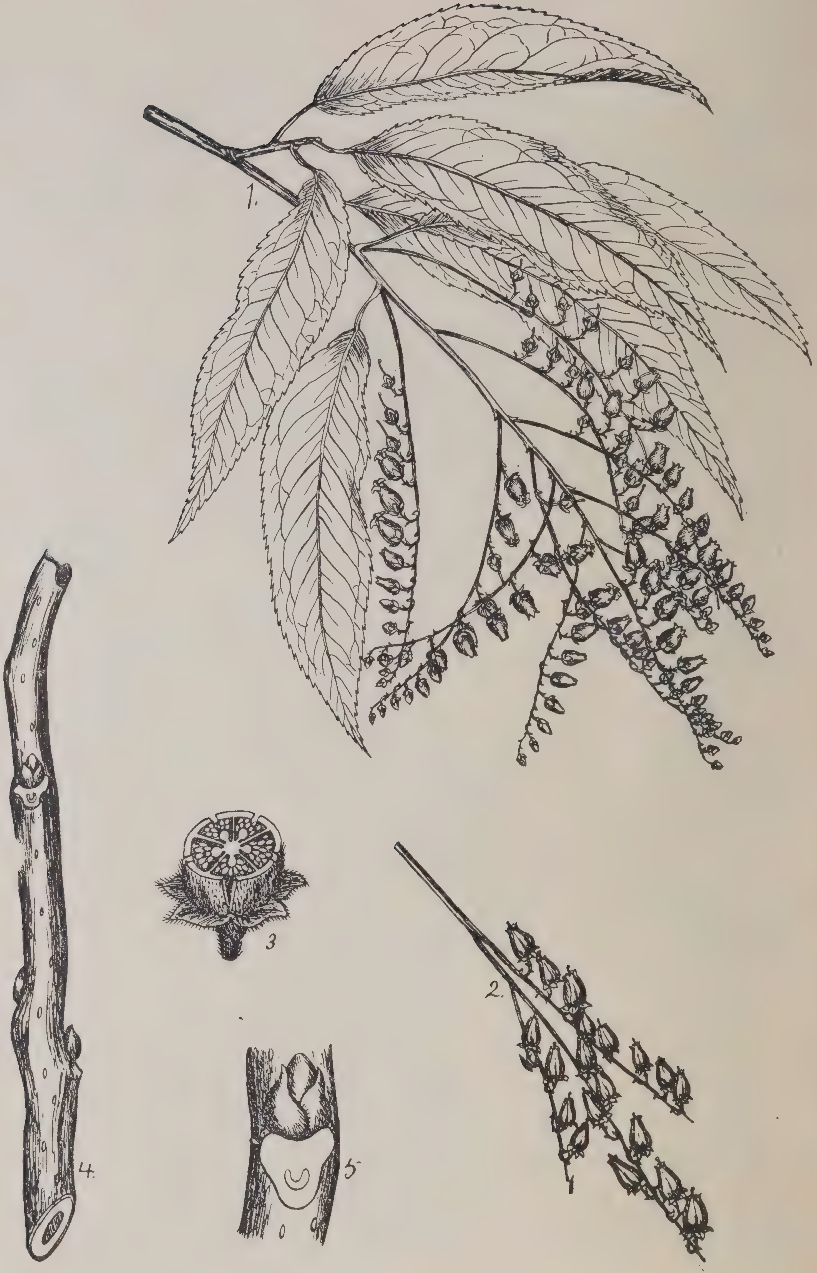

PLATE CXXI. SOUR-WOOD

1. A flowering branch with long one-sided racemes of flowers clustered in an open panicle, x ½.
2. A few racemes of fruit, x ½.
3. Cross-section of a capsule showing five cells filled with seeds, slightly enlarged.
4. A winter twig, enlarged.
5. Section of a winter twig, enlarged.

SOUR-WOOD

Oxydendrum arboreum, (Linnaeus) De Candolle

GENUS DESCRIPTION—The Sour-wood is the sole representative of the genus Oxydendrum. The word Oxydendrum means acid tree, in allusion to the acid foliage.

FORM—A medium-sized tree which may reach a height of 50-60 ft. with a diameter of 20 inches, but usually is about 25 ft. in height with a diameter of 8 inches. Trunk usually straight, tall, slender, and bears a narrow round-topped crown.

BARK—Rather thick, roughened by fissures which separate rounded ridges covered with thick scales. On old trunks grayish often tinged with red; on young branches reddish-brown.

TWIGS—Rather slender, at first yellowish-green, later orange-colored and reddish-brown. Marked with numerous, oblong, elevated lenticels.

BUDS—Alternate, axillary; terminal buds absent; small, partly imbedded in the bark, acute at apex, covered with several opposite dark red scales.

LEAVES—Alternate, simple, oblong, stalked, acute at apex, wedge-shaped at base, serrate on margin, very smooth, 5-7 inches long, 1½-2½ inches wide.

LEAF-SCARS—Alternate, elevated, nearly triangular, with a single compounded bundle-scar.

FLOWERS—Appear about July. White, perfect, with cylindrical corolla, and borne in racemes often 6-8 inches long.

FRUIT—A 5-sided, 5-valved capsule terminated by a persistent style. Matures in September only a month or six weeks after the flowers. Capsules often persist in clusters.

WOOD—Diffuse-porous; hard, heavy, compact, reddish-brown with lighter sapwood. Medullary rays are numerous but narrow. Weighs 46 lbs. per cubic foot. Used locally for runners of the Appalachian tanbark sleds, and for tool handles.

DISTINGUISHING CHARACTERISTICS—The Sour-wood, also known as Sorrel-tree and Sour Gum, can be distinguished in summer by its white bell-shaped flowers which are arranged in racemes resembling the lily-of-the-valley. The alternate bitter leaves which resemble the peach leaf are also characteristic. The bark on older trees resembles that of the Black Gum. The winter buds, which are dark red, alternate, very small, often partly imbedded by bark, are also characteristic.

RANGE—Pennsylvania and Indiana south to Florida and western Louisiana.

DISTRIBUTION IN PENNSYLVANIA—Found only sparsely in the southwestern part of the State. Reported from Mt. Pleasant, Fayette county, and a field near Brush Creek, in Westmoreland county.

HABITAT—Usually frequents well-drained soils. Commonly found on hillsides, seldom along streams.

IMPORTANCE OF THE SPECIES—The Sour-wood is native only to a very small portion of southwestern Pennsylvania. Its small size and limited distribtuion in this State prevent it from being recommended for forestry purposes. It is, however, an attractive ornamental tree on account of its form, late flowering, beautiful and attractive autumnal foliage.

COMMON PERSIMMON

Diospyros virginiana, Linnaeus

FAMILY AND GENUS DESCRIPTION—The Ebony family, Ebenaceae, is widely distributed in the tropics, and only a few representatives are found in the temperate regions. It comprises about 6 genera with more than 250 species. The most important genus is Diospyros which has 2 representatives in the flora of the United States and 1 in Pennsylvania. This genus comprises about 160 species found mostly in the tropics. Members of this genus produce some of the ebony of commerce, and valuable foods in China and Japan. The species described below is the sole representative of this genus in eastern North America. One other species is found in the southern and western parts of Texas.

FORM—A small tree usually from 25 to 50 ft. in height with a diameter of less than 12 inches, but may reach a height of 100 ft. with a diameter of 2 feet. Trunk usually short and slender. Crown high and broad-topped. It often spreads by roots migrating under the ground, forming dense thickets.

BARK—On old trunks thick, hard, dark gray to dark brown or black, cinnamon-red at the bottom of the fissures; separates into thick squarish blocks which peel off into thin scales. See Fig. 120.

TWIGS—Slender, bitter, astringent, grayish to reddish-brown becoming darker in second year, usually pale pubescent, covered with a few scattered orange-colored lenticels, and contain large pith or pith chamber.

BUDS—Alternate, broadly ovate, closely pressed against twig, ⅛ of an inch long, sharp-pointed, covered by 2 dark brown glossy scales; terminal bud absent.

LEAVES—Alternate, simple, oval, acute at apex, entire on margin, wedge-shaped to heart-shaped at base, 4-6 inches long, thick, dark green and shiny above, often hairy below. Leaf-stalks are ½-1 inch long, and contain 1 fibro-vascular bundle.

LEAF-SCARS—Alternate, elevated, flattened, contain 1 prominent bundle-scar which is transversely-elongated, or several becoming confluent.

FLOWERS—White, appearing about May or June. Staminate and pistillate flowers occur separate. Staminate arranged in 2-3 flowered cymes. Pistillate solitary, and borne on short stalks.

FRUIT—A juicy, spherical, orange-colored, often red-cheeked berry with remnants of style persisting and seated in enlarged green calyx. Often very astringent. Sometimes edible before frost appears. Contains from 1-8 seeds, usually 4-6.

WOOD—Ring-porous; heavy, hard, compact, susceptible to a high polish, strong; heartwood is brown to black but usually forms late; sapwood is wide, yellowish and often streaked with black. Weighs about 49 lbs. per cubic foot. Used for shuttles, golf club heads, billiard cues, mallets, parquet flooring, brush backs, veneer.

DISTINGUISHING CHARACTERISTICS—The Persimmon, also known as Date-plum and Possum-wood, can be distinguished in summer by its alternate, simple, entire-margined, deep green leaves with only 1 fibro-vascular bundle in the leaf-stalk and the rough bark which is often broken up into quadrangular blocks and is evidently cinnamon-red at the base of the fissures. In autumn the fruit is characteristic. In winter the rough bark with cinnamon-red color at the bottom of the fissure, the semi-orbicular leaf-scars with only 1 bundle-scar, the broadly ovate buds with 2 dark brown scales, the reddish-brown slightly pubescent twigs with relatively large pith or pith cavity, and the persistent remnants of flowers are distinctive.

RANGE—Connecticut to Florida, westward to Iowa and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southern parts. Local in the southwestern part and occasional in the central part. Absent in the northern part and Allegheny Mountain region. In the southwestern part reported from Allegheny, Greene, Washington, and Westmoreland counties. A small group of trees have been reported from Beans Cove, in southern Bedford county, near the Mason and Dixon line. Found in all the counties southeast of the Blue Mountains, that is, below a line drawn from Northampton, through Dauphin to Fulton county. It extends beyond this line along the main river valleys. In the Susquehanna Valley it extends as far as Union county and follows the Juniata into Huntingdon and Mifflin counties. A few small outposts are reported from Centre county. Large specimens occur in the extreme southeastern part of the State. Trees 18 inches in diameter occur as far north as Easton in Northampton county. Not reported north of the Delaware Water Gap.

HABITAT—Prefers a light, somewhat sandy well-drained soil. Tolerates rich bottomlands especially in the South.

IMPORTANCE OF THE SPECIES—The Persimmon is too small in size and too limited in distribution in this State to be of commercial importance from the point of view of wood production. It is essentially a southern tree. The tree has an attractive form, beautiful clean foliage, and an exceptionally attractive bark. It rarely exceeds 40 feet in height with a diameter of 12 inches in this State.

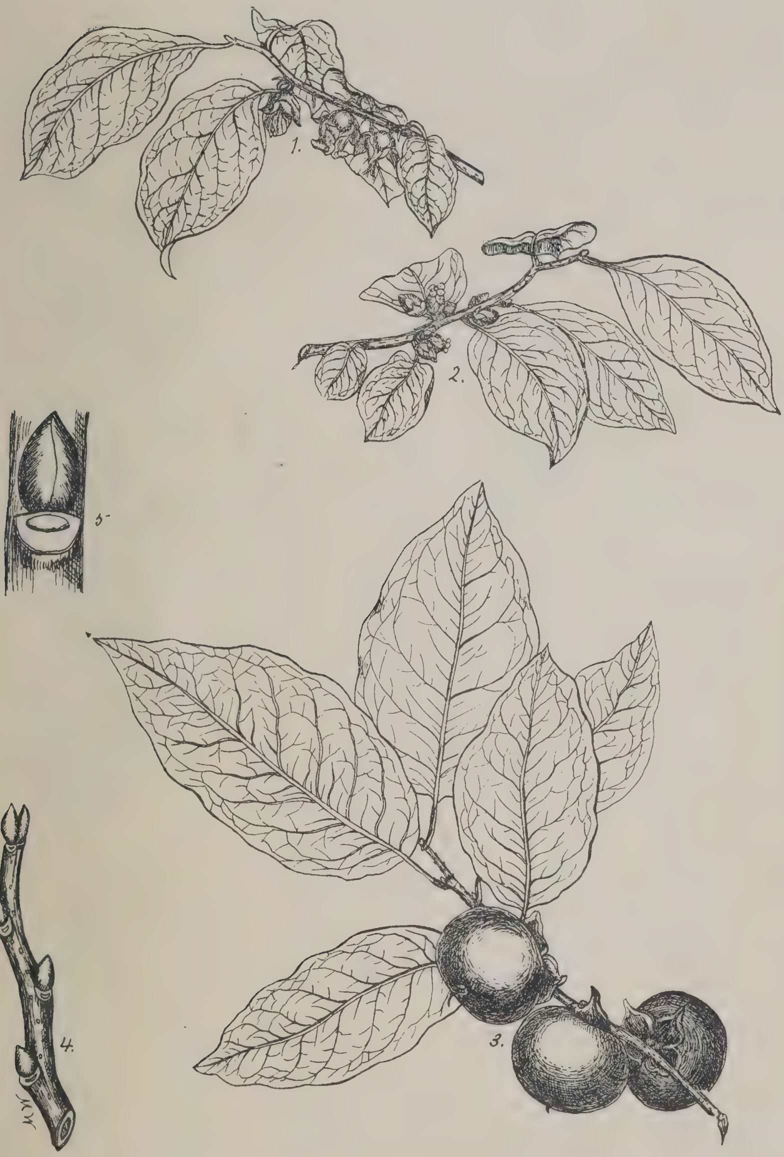

PLATE CXXII. COMMON PERSIMMON

1. A branch with pistillate flowers, x ½.
2. A branch with staminate flowers, x ½.
3. A fruiting branch with mature leaves, x ½.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

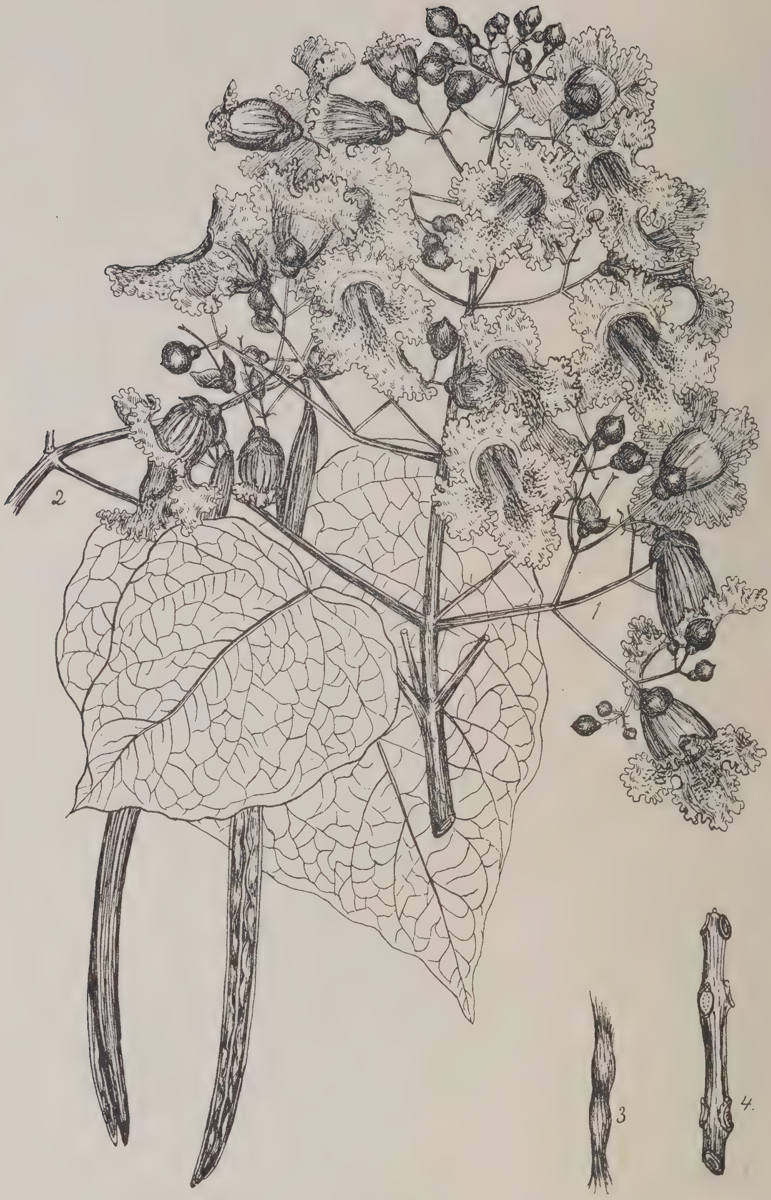

PLATE CXXIII. CATALPA

1. A panicle of flowers, x ½.
2. A branch with two drooping cigar-like fruits, the one split open showing the seeds, x ½.
3. A winged seed, x ½.
4. A winter twig, x ½. See Plate II.

CATALPA

Catalpa bignonioides, Walter

FAMILY AND GENUS DESCRIPTION—This tree belongs to the Bignonia family, Bignoniaceae, which comprises about 100 genera with 1,500 species. Most of the representatives of this family occur in the tropics; only a few are found in the temperate zone. They occur as trees, shrubs, woody climbers, and rarely as herbs. North America has only 6 genera with 8 species in its flora and Pennsylvania 3 genera with 3 species. The genus Catalpa is the only one which has tree representatives occurring rather frequently in this state. This genus comprises about 7 species in the world, of which number 2 are native to North America. No representative of this genus is native to Pennsylvania but 1 species has been naturalized so extensively in every part of the State, that a description of it in this publication was considered desirable.

FORM—Usually 25-40 ft. high but may reach a height of 60 ft., with a diameter of 3 feet. Trunk usually short, crooked, often angular, and unattractive. Crown high, broad, and rather symmetrical in appearance in summer, due to the dense foliage.

BARK—Light brown, rather thin, shallowly-ridged, scaly, bitter.

TWIGS—Stout, smooth, or slightly downy, yellowish-brown, usually frozen back in the north, covered with numerous large lenticels, roughened by leaf-scars. Pith large, white, sometimes chambered at the nodes. See Plate II, 2.

BUDS—Terminal bud usually absent. Lateral buds small, almost imbedded in bark, usually less than ⅛ of an inch long, covered with 5-6 visible, small, brown bud-scales.

LEAVES—Opposite or whorled, i. e., more than two at a node, simple, 6-10 inches long, 4-5 inches broad, ovate, heart-shaped at base, acute at apex, entire or wavy on margin. Fall simultaneously after first heavy frost.

LEAF-SCARS—Opposite or 3 at a node, large, conspicuous, with projecting margin, elliptical in outline, with conspicuous bundle-scars usually arranged in an ellipse.

FLOWERS—Appear in June or July. Perfect, arranged in many-flowered crowded panicles from 8-10 inches long. Corolla is conspicuously spotted on inner surface.

FRUIT—A long, cylindrical, bean-like capsule which often persists far into winter and contains many flattened winged seeds. Wings surround seeds and are fringed at ends. Tree is sometimes called Indian Bean on account of fruit.

WOOD—Ring-porous; distinct demarcation between heartwood and sapwood; odor somewhat like kerosene; light, soft, coarse-grained; durable in contact with soil, light brown, and has a satiny surface. Weighs about 26 lbs. per cubic foot. Used mainly for cross-ties, posts and poles.

DISTINGUISHING CHARACTERISTICS—The Eastern Catalpa, also known as Catalpa, Indian Bean and Cigar Tree, can be distinguished in summer by its leaves which are opposite or whorled and its large panicles of flowers. The cigar-like or bean-like fruit is characteristic in autumn and winter. In winter it can be distinguished by its large elliptical leaf-scars which are opposite or whorled and have their bundle-scars arranged in an ellipse. The pith is sometimes chambered at the nodes. The Eastern Catalpa closely resembles the Western Catalpa but has slender and thinner walled fruit, larger flower-clusters, more distinct markings on inner surface of corolla, and more blunt-pointed leaves. The Western Catalpa is more frost hardy than the Eastern Catalpa.

RANGE—Original range was limited to parts of Georgia, Alabama, Mississippi, and Florida. At present found in all parts of the country east of the Rocky Mountains and as far north as New England.

DISTRIBUTION IN PENNSYLVANIA—Planted for ornamental purposes in many parts of the State and has escaped cultivation in practically every part of the State. Individual specimens or small groups of trees are common in the forest near settlements. Numerous plantations, some comprising 5,000 to 10,000 trees, have been established in various parts of the State. Their growth, as a rule, has not been satisfactory. On the Mont Alto State Forest is a large plantation which at the age of thirteen years reached only an average height of seven feet.

HABITAT—Prefers moist and fertile situations, is most common along streams and river banks, but also found in drier places. Prefers shaded to open situations.

IMPORTANCE OF THE SPECIES—Two species of Catalpa are commonly recognized, the Eastern Catalpa and the Western or Hardy Catalpa. Both have been widely advertised. The Western species is hardier against frost and produces a straighter and cleaner trunk. Neither of the 2 species should be planted for forestry purposes in this State. Both species produce beautiful flowers and foliage and attractive fruit.

THE OLIVE FAMILY—OLEACEAE

The Olive family comprises representatives which are widely distributed in temperate and tropical regions, but are commonest in the northern portion of both hemispheres. A great variety of trees and shrubs is embraced by this family, some of which are valuable timber trees, while others are valuable for ornamental purposes or for the food which they yield. The most important is the Olive Tree (Olea Europaea, L.), whose fruit and the oil derived from it are used almost universally as food. The Olive Tree was cultivated in ancient times in Syria and Palestine; later it was introduced into the Mediterranean region, where one can find large orchards of it at the present time; and within the past few decades it has been introduced on a large scale into the southwestern part of the United States. The Ashes which are among our most valuable timber trees, the Forsythias and Lilacs which are among our most attractive and popular shrubs, and the Privets, which are used so extensively as hedge plants, are also members of this family.

The Olive family comprises about 21 genera with 500 species of trees, shrubs, and a few herbs. The flora of North America contains 5 genera with about 20 species, while that of Pennsylvania contains 4 genera with 9 species. Only 2 of the 4 genera native to Pennsylvania have tree representatives.

KEY TO THE GENERA

		Page
1. Leaves compound; fruit a dry samara; flowers without a corolla; winter buds with 3-4 pairs of scales,	**Fraxinus**	218
1. Leaves simple; fruit a fleshy berry; flowers with a corolla; winter buds with more than 4 pairs of scales,	**Chionanthus**	223

THE ASHES—FRAXINUS, (Tourn.) L.

The Ashes with one or two exceptions are trees, which occupy a variety of situations but prefer rich, moist soil. Some species may also be found occasionally in swamps or along streams, while others frequent dry and poor uplands. The trees are usually straight, have little stem taper, and often attain large dimensions. They are, locally, rather abundant and yield wood which is straight-grained. strong and elastic. The wood of all the eastern species except that of the Black Ash, is solid as White Ash. This classification is legitimate since there is little difference for practical purposes. They are also valuable as shade trees. Our native species and the introduced European species (Fraxinus excelsior, L.) are planted rather extensively in parks and lawns. The trunk and leaves of Fraxinus ornus, L., a species of southern Europe and Asia Minor, yield the manna of commerce.

The Ashes may be regenerated by natural and artificial methods. The natural regeneration may be accomplished by means of regulated cutting the mature trees accompanied by the establishment of a young growth from the seed scattered by the seed trees which remain, or by means of coppicing. Coppicing is a practical method or regeneration especially on rich, moist soils and where very large sizes are not required. The artificial regeneration may be accomplished by sowing seeds, or what is still better, by collecting the seeds, planting them in the nursery, and after a year's growth in the nursery, lifting them and planting them out upon the area where they are to remain and produce a timber crop.

The leaves of the Ashes are opposite and compound. The leaflets occur in 2s opposite each other along the principal leaf-stalks, with a single leaflet at the end, hence the total number of leaflets is always odd. The twigs are stout and occur in pairs opposite each other along the main axis. The branchlets are usually flattened at the nodes. The flowers are produced in dense clusters and usually appear in spring before the leaves have made their appearance. The fruit, known as a samara, occurs in clusters and matures in fall. The individual seed is winged at one end. This wing aids in the dispersal of the seed by the wind, which is the most important dispersing agent; but water may also scatter a large quantity of the seeds, especially of such species which are commonest near the streams or where flood waters occur.

The Ashes are distributed throughout the north temperate zone and comprise about 40 known species of which number 16 occur in North America and 4 in Pennsylvania. Three species are common in this State, while another species known as the Biltmore Ash (Fraxinus Biltmoreana, Beadle), is found locally only over a limited region in the southern part of the State. A variety of the Red Ash known as the Green Ash (Fraxinus pennsylvanica var. lanceolata) is also found locally in the southern part of the State.

SUMMER KEY TO THE ASHES

Page

1. Leaves with sessile leaflets; seed surrounded by wing; bark scaly, not furrowed with diamond-shaped fissures. .... F. nigra 221
1. Leaves with stalked leaflets; seed partly surrounded by wing; bark furrowed with diamond-shaped fissures, ... 2

2. Leaves and twigs smooth or nearly so; seed usually winged only at apex, ... F. americana 220
2. Leaves and twigs velvety pubescent; seed winged usually at apex and sides, ... F. pennsylvanica 222

WINTER KEY TO THE ASHES

1. Buds usually black and acute at apex; bark scaly, not furrowed with diamond-shaped fissures; tall and slender. .... F. nigra 221
1. Buds rusty to dark brown, usually obtuse at apex; bark furrowed with diamond-shaped fissures; tall but stout, ... 2

2. Twigs smooth or nearly so; leaf-scars evidently indented on upper margin. F. americana 220
2. Twigs velvety pubescent; leaf-scars not evidently indented on upper surface. .... F. pennsylvanica 222

WHITE ASH

Fraxinus americana, Linnaeus

FORM—Usually reaches a height of 70-80 ft. with a diameter of 2-3 ft., but may attain a height of 120 ft. with a diameter of 5-6 ft. Trunk usually tall, massive, clear of branches for a considerable distance from the ground when grown in the forest, bearing a narrow, somewhat pyramidal crown. When open-grown the crown is decidedly round-topped and often extends almost to the ground. In forest-grown trees trunk often continuous and dividing into a number of spreading branches.

BARK—Grayish-brown, rather thick upon older trunks, decidedly divided by diamond-shaped fissures into rather flattened ridges which are covered by thin, close-fitting scales. Longitudinal ridges often transversely-fissured so that the primary fissures are connected. See Fig. 105.

TWIGS—Opposite, stout, usually smooth, sometimes covered with a slight bloom, decidedly flattened at the nodes. During the first winter grayish-brown in color, and decidedly lustrous; covered by scattered, large, pale lenticels.

BUDS—Opposite, ovate, blunt-pointed, usually dark brown, occasionally almost black. Terminal bud larger than laterals, covered by 2-3 pairs of visible scales which occur opposite each other. Scales on the terminal buds may be somewhat sharp-pointed, while those on the lateral buds are usually obtuse. Two lateral buds are usually found at base of terminal bud causing a terminal enlargement of twig.

LEAVES—Opposite, compound, about 10 inches long with 5-9 leaflets. Leaflets 3-5 inches long, about 1½ inches broad, evidently-stalked, slightly serrate on margin, acute at apex, wedge-shaped to rounded at base. When full grown usually smooth and dark green above and pale below. A few hairs are sometimes found along the veins on the lower surface.

LEAF-SCARS—Opposite, semi-circular in outline, notched on the upper margin, raised, conspicuous; bundle-scars small, numerous, arranged in a curved line.

FLOWERS—Appear about May before the leaves. The staminate and pistillate on different trees. Staminate occur in dense reddish-purple clusters; pistillate in rather open panicles.

FRUIT—A samara borne in dense drooping panicles about 7 inches long. Panicles often persist far into winter. Individual samara 1-2 inches long, consists of a seed bearing portion and a winged portion. Seed portion round in cross-section, terminated by the wing which aids in the dispersal of the seed. Since some trees bear staminate flowers only, seeds are never found upon them.

WOOD—Ring-porous; very heavy and strong, odorless and tasteless, tough, elastic, and white to brown in color, with thick and lighter colored sapwood. Pores in spring wood large, usually 3-10 rows wide; in summer wood isolated or in groups of 2-3, and usually joined by wood parenchyma. Weighs 41 lbs. per cubic foot. Used in the manufacture of agricultural implements, wagon building, furniture, interior finishing of houses, and for tool handles.

DISTINGUISHING CHARACTERISTICS—The White Ash, also known as the Canadian Ash, can be distinguished from the Black Ash by its leaves which have stalked leaflets, while the leaflets of the Black Ash are sessile. The buds of the White Ash are usually obtuse and brown in color, while those of the Black Ash are usually acute and black in color. The bark of the White Ash is usually furrowed and has diamond-shaped fissures between the ridges while the bark of the Black Ash is scaly, often corky and not furrowed. It can be distinguished from the Red Ash by its smooth leaves and twigs. Those of the Red Ash are usually velvety-pubescent. The leaf-scars of the White Ash are usually evidently-indented in the upper margin, while those of the Red Ash are not. The leaflets of the White Ash are entire-margined or obscurely toothed and silvery white on the lower surface while those of the Green Ash are evidently toothed and green on both sides. The seeds of the White Ash have wings which are fastened only to the apex of the seed, while in the Red Ash they are fastened to the apex and often extend down along the sides, and in the Black Ash the wing usually surrounds the seed. The Biltmore Ash (Fraxinus Biltmoreana, Beadle), found only locally through the southern part of the State, is only a pubescent form of the White Ash. The twigs and lower surface of leaflets of the former species are pubescent. It is adapted to somewhat drier sites, and grows more rapidly in youth than the White Ash. Its chief occurrence is on the limestone formation of Ohio, Indiana, Kentucky, and Tennessee.

RANGE—Nova Scotia to Minnesota and southward to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Generally distributed throughout the State. Common in the eastern, southern, central, and western parts. Sparse in the mountainous parts, except in moist valleys and rich bottomlands. Locally it is rare in northern Pennsylvania, where it reaches its best development on moist slopes with a northern exposure.

HABITAT—Prefers fertile, moist soils; very common in rich, moist woods and along streams, lakes, and other bodies of water. Occasionally found on rather dry hillsides.

IMPORTANCE OF THE SPECIES—The White Ash is one of the most important timber trees of Pennsylvania on account of the large size which it attains, its general distribution throughout the State, its rapid growth, as well as its immunity from the attack of fungous diseases and insects . Nature did not produce it in pure stands, hence in developing our future forests we should aim to follow nature and plant White Ash in mixture with some other desirable species. White Ash and White Pine will undoubtedly prove to be a valuable mixture.

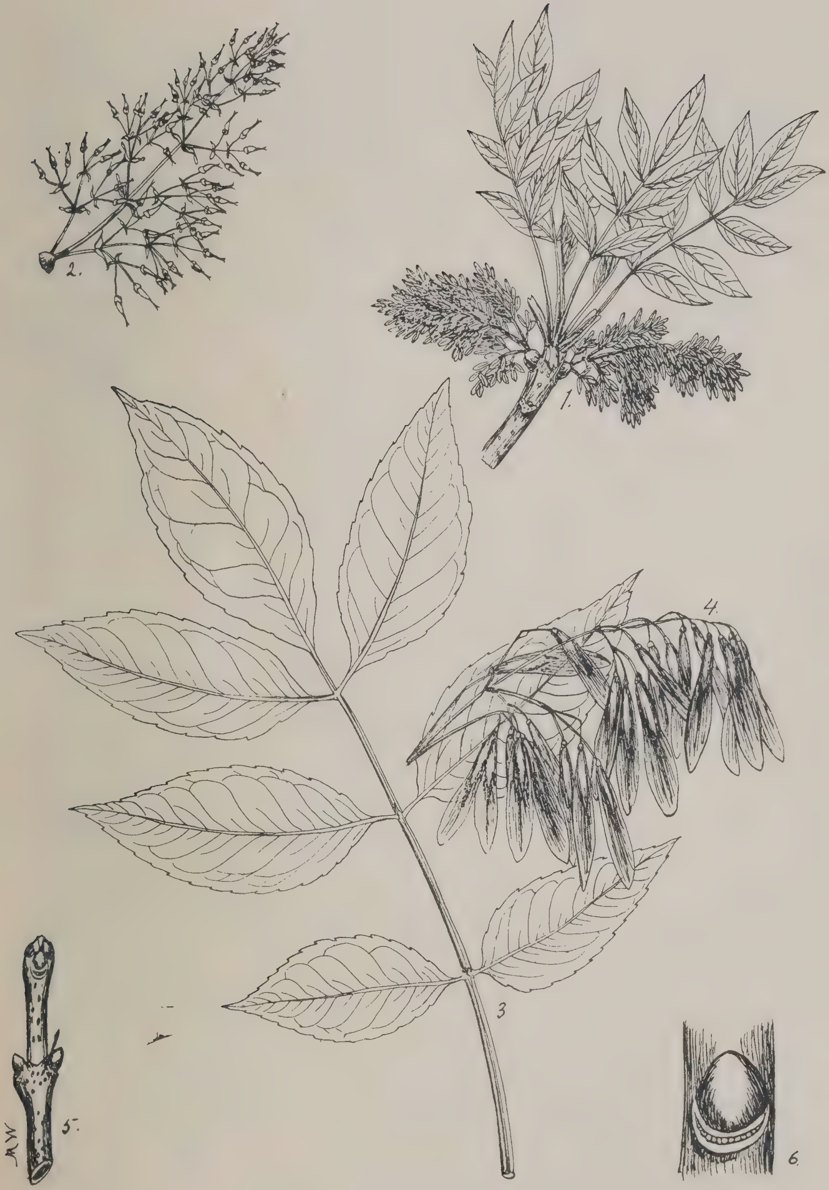

PLATE CXXIV. WHITE ASH

1. A branch with a cluster of staminate flowers and immature leaves, x ½.
2. A panicle of pistillate flowers, x ½.
3. A mature compound leaf, x ½.
4. A cluster of fruit, x ½.
5. A winter twig, x ½.
6. Section of a winter twig, enlarged.

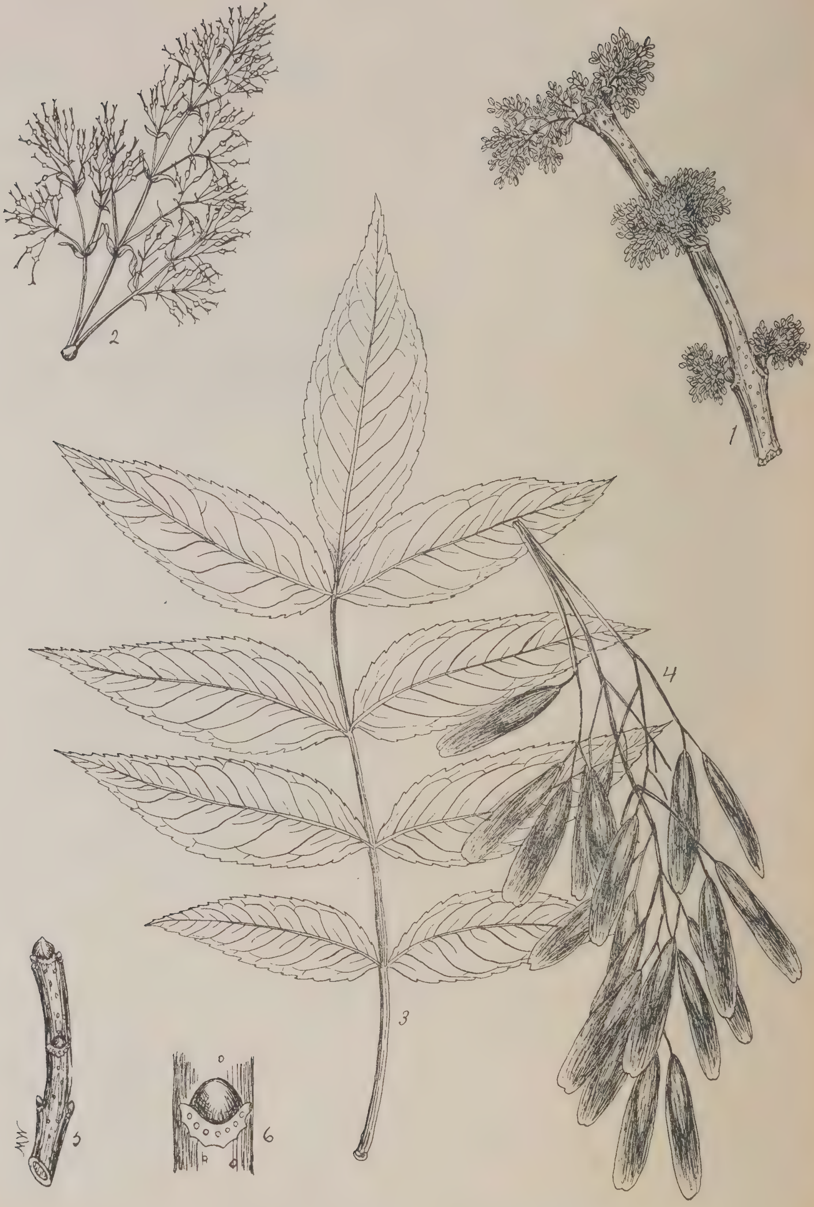

PLATE CXXV. BLACK ASH

1. Branch with staminate flowers, x ½.
2. A panicle of pistillate flowers, x ½.
3. A mature compound leaf, x ½.
4. A cluster of fruit, x ½.
5. A winter twig, x ½.
6. Section of a winter twig, enlarged.

BLACK ASH

Fraxinus nigra, Marshall

FORM—A medium-sized tree which usually attains a height of 60-80 ft. with a diameter of 1-2 ft., but may reach a height of 100 ft. with a diameter of 2½ ft. It usually has a rather tall, slender trunk often free from branches for a considerable distance from the ground, bearing a narrow and shallow crown formed by numerous rather upright branches. Usually found in the forest, where the slender form prevails, but occasionally may be found in the open, where its form resembles that of the White Ash.

BARK—Thin, grayish, shallowly and irregularly fissured; ridges between the fissures decidedly scaly and somewhat corky. By rubbing the bark it breaks up into a very fine powder. See Fig. 106.

TWIGS—Rather stout, at first somewhat hairy, but soon becoming quite smooth. Resemble those of the White Ash but lighter in color, and not so smooth and glossy.

BUDS—Opposite; terminal bud present, ovate, sharp-pointed, black, covered with 1-2 pairs of visible bud-scales, usually at some distance from nearest lateral buds; lateral buds usually almost as broad as long, often obtuse at apex, closely appressed to twigs.

LEAVES—Opposite, compound, about 14 inches long, with 7-11 sessile leaflets. Leaflets are all sessile except the terminal one, 3-5 inches long, about 1½ inches wide, acute at the apex, serrate on the margin, wedge-shaped at the base, dark green and smooth above, paler below.

LEAF-SCARS—Opposite, large, conspicuous, crescent-shaped, upper margin usually straight or convex; bundle-scars numerous arranged in a curved line, sometimes joined so as to form a compound scar.

FLOWERS—Appear about May before the leaves. Staminate and pistillate borne on the same or different trees; the staminate in dense, dark purplish clusters; the pistillate in rather open panicles.

FRUIT—A samara which resembles the fruit of the White and Red Ashes, but differs in that the wing is broader, decidedly notched at the apex, and completely surrounds the somewhat flattened seed-bearing portion.

WOOD—Ring-porous; medium in weight, hardness and strength, comparatively soft, rather coarse grained, somewhat durable. Heartwood dark brown with white sapwood; marked difference between spring and summer wood; annual layers of the wood easily separated. Pores in spring wood in a broad zone often comprising one-half of the ring. Pores in summer wood large, few, scattered. Weighs 39 lbs. per cubic foot. Used in the manufacture of baskets, hoops, chair bottoms, and the interior finishing of houses.

DISTINGUISHING CHARACTERISTICS—The Black Ash, also known as Hoop, Swamp, Basket, and Brown Ash can readily be distinguished from the other native species of ash in summer by the opposite and compound leaves with sessile lateral leaflets; the leaflets on all other native species being evidently-stalked. In winter it can be identified by its raised upper margin of the leaf-scar and the black, ovate, and sharp-pointed buds, and in autumn by its fruit, the body and seed kernel of which are flat and the wing of which extends to the base of the seed, while in the other native species the seed kernel is round or nearly so, and the wing does not extend beyond the middle of the seed. In addition to these seasonal characteristics the tree may be recognized at any period of the year by its distinctive slender form, clean trunk, shallow-crown, and thin, grayish, and non-fissured bark which is usually soft and corky, and if rubbed with the hand it becomes mealy. The twigs, as a rule, are stouter and less numerous than in the other native species.

RANGE—Newfoundland to Manitoba, south to Delaware, Virginia, and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Generally distributed over the State, but rare in the high mountainous portion, except in moist valleys. Common in the eastern, southern, central, and northwestern parts, and rare in the southwestern part.

HABITAT—Prefers cool swampy habitats, in this respect differing very much from the other species of Ash native to the State. Flourishes best in the cooler portions of its range. Its chief commercial occurrence is in the northern half of the Lake States. Seldom thrives on dry ground.

IMPORTANCE OF THE SPECIES—The Black Ash has probably never been grown for forestry purposes. It may be so recommended where natural reproduction may be depended upon and in such locations where other more valuable trees will not grow. Few better species grow in its chosen swampy home and consequently it may be one which we will plant in the future in extremely wet locations together with such other trees as Spruce, Fir, and Larch.

RED ASH

Fraxinus pennsylvanica, Marshall

FORM—Tree of middle or large size, usually attaining a height of 30-60 ft. with a diameter of 1-3 ft., but may reach a height of 70 ft. with a diameter of 5 feet. Trunk similar to that of White Ash, but smaller and bearing numerous upright branches which form a rather irregular and compact crown.

BARK—Grayish-brown, roughened by numerous fissures separating prominent ridges which in time become scaly. Fissures usually diamond-shaped. Ridges often sub-divided by transverse secondary fissures.

TWIGS—Similar to those of the White Ash but not so stout and covered with a dense velvety pubescence, or sometimes almost smooth. See "Twigs" under White Ash, page 220.

BUDS—Opposite; terminal bud present; ovate, brown, covered by brownish scales, 2 pairs of which are usually visible. Scales of the lateral buds usually have an obtuse apex while those of the terminal buds have a more acute apex. See "Buds" under White Ash, page 220.

LEAVES—Opposite, compound, about 11 inches long, with 5-9 stalked leaflets. Leaflets from 3-5 inches long, 1-1½ inches wide, ovate, acute at apex, slightly toothed on margin, wedge-shaped at base. At first coated on the lower surface with white tomentum, later becoming yellowish-green above, and decidedly velvety-pubescent beneath.

LEAF-SCARS—Opposite; semi-circular in outline, conspicuous, slightly notched on the upper margin; bundle-scars numerous, usually small, and arranged in a curved line. Sometimes a number of bundle-scars unite to form a compound bundle-scar.

FLOWERS—Appear about May before or with the leaves. Staminate and pistillate are usually borne on different trees. Staminate occur in dense purplish-red clusters; pistillate in open greenish-red panicles.

FRUIT—A samara, borne in open panicles which often persist far into winter. The individual samara varies in length from 1-2 inches, and consists of a seed-bearing portion and a winged portion. Fruit resembles that of the White Ash, but has the winged portion attached not only to the apex of the seed but also along the sides, while the White Ash has the wing attached at the apex only.

WOOD—Ring-porous; heavy, hard, rather strong, light brown, with rather wide and light colored sapwood. Pores in the spring and summer wood are similar to those of the White Ash, but the lines of pores in the summer wood are longer than in the White Ash. Weighs 44 lbs. per cubic foot. Used for the same purposes as the White Ash, but is somewhat inferior to it from a commercial point of view.

DISTINGUISHING CHARACTERISTICS—The Red Ash can be distinguished at any season of the year from the other native species of Ash, except the Biltmore Ash, by its velvety-pubescent twigs and petioles and the reddish color of the inner bark of the branches. It can also be distinguished from the White Ash by its somewhat smaller maximum size, the shallower fissures of the bark and the fruit, the wings of which are attached to the apex and sides of the seed while those of the White Ash are attached only to the apex. The main distinguishing characteristics between this species and the Biltmore Ash are found in the fruit and range. The fruit of the Red Ash tapers gradually along the edges into the linear or spatulate wing which is decurrent along the body of the seed to the middle, while the fruit of the Biltmore Ash is linear-oblong, tapers little, and the wing is attached only to the end of the short and stout body of the fruit. The lateral leaflets of the Red Ash are stalked while those of the Black Ash are stalkless. The Red Ash has brown and blunt-pointed buds; those of the Black Ash are black and sharper pointed. The bark of the Red Ash, while not so prominently fissured as that of the White Ash, can be distinguished very readily from the non-fissured, soft, scaly, and semi-corky bark of the Black Ash. The smooth-branched Green Ash (Fraxinus pennsylvanica var. lanceolata (Borkh.) Sarg. is generally regarded as only a variety of the Red Ash.

RANGE—New Brunswick and Manitoba, south to Florida and Alabama, and westward to Dakota and Missouri.

DISTRIBUTION IN PENNSYLVANIA—Known to occur in the eastern and southern parts of the State. Also reported from the central part. The Green Ash, a variety of the Red, is reported as occurring in Westmoreland and Allegheny counties in the western part of the State. Not reported from the northern or northwestern parts, but its general range indicates that it may occur there.

HABITAT—Prefers rich soil in valleys; also found in swampy lowlands and along the margins of streams, lakes, and ponds; occasionally found upon rather dry hillsides.

IMPORTANCE OF THE SPECIES—The Red Ash in many respects resembles the White Ash, but it is of less economic importance since it does not attain so large a size as the White Ash, its wood is not quite so valuable, and it requires a somewhat moister soil. The White Ash will grow in all places where the Red Ash thrives, and consequently the White Ash should be favored. It is sometimes planted for ornamental purposes but the White Ash is generally regarded more attractive and just as free from the attacks of insects and fungi. The only place where the Red Ash could be recommended for planting for forestry purposes would be in such situations where it is too wet for the White Ash to thrive.

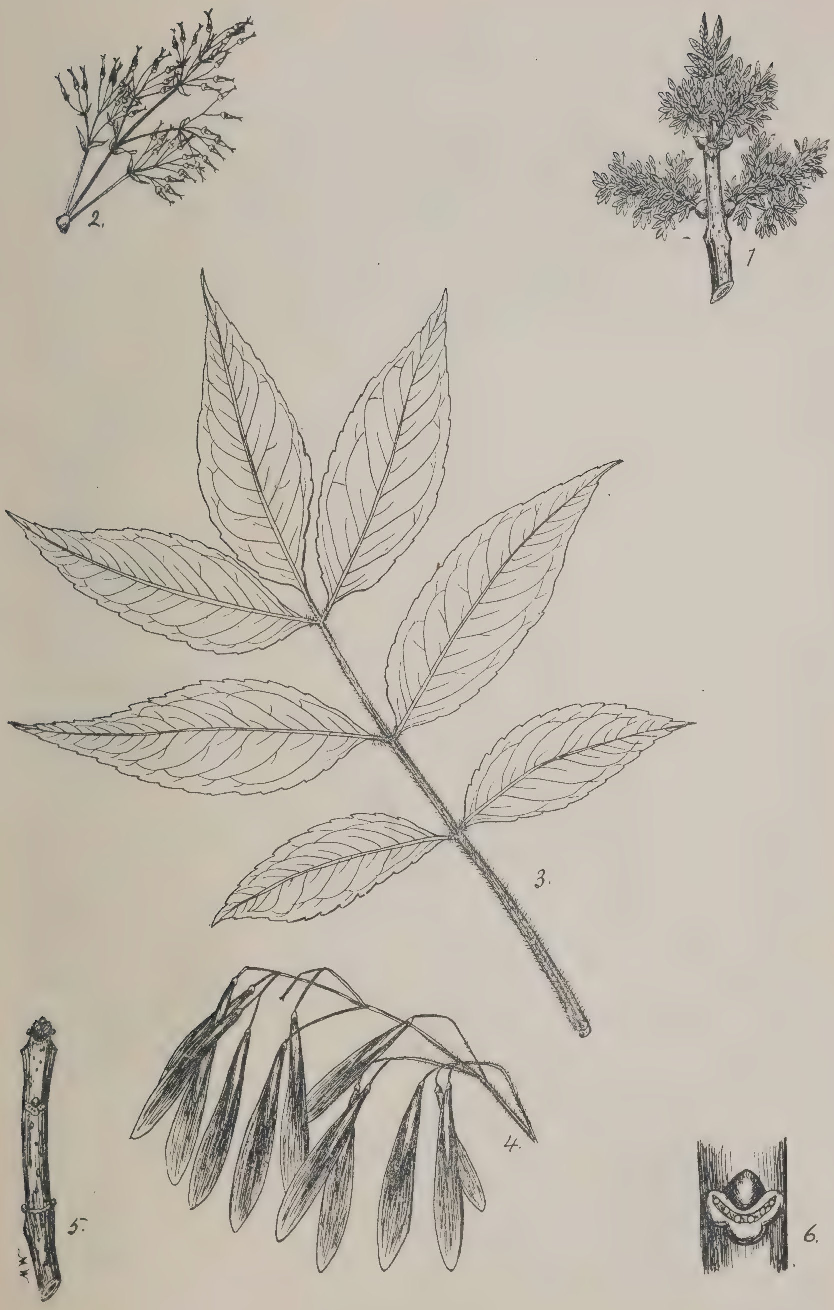

PLATE CXXVI. RED ASH

1. Branch with staminate flowers, x ½.
2. A panicle of pistillate flowers, x ½.
3. A mature compound leaf, x ½.
4. A cluster of fruit, x ½.
5. A winter twig, x ½.
6. Section of a winter twig, enlarged.

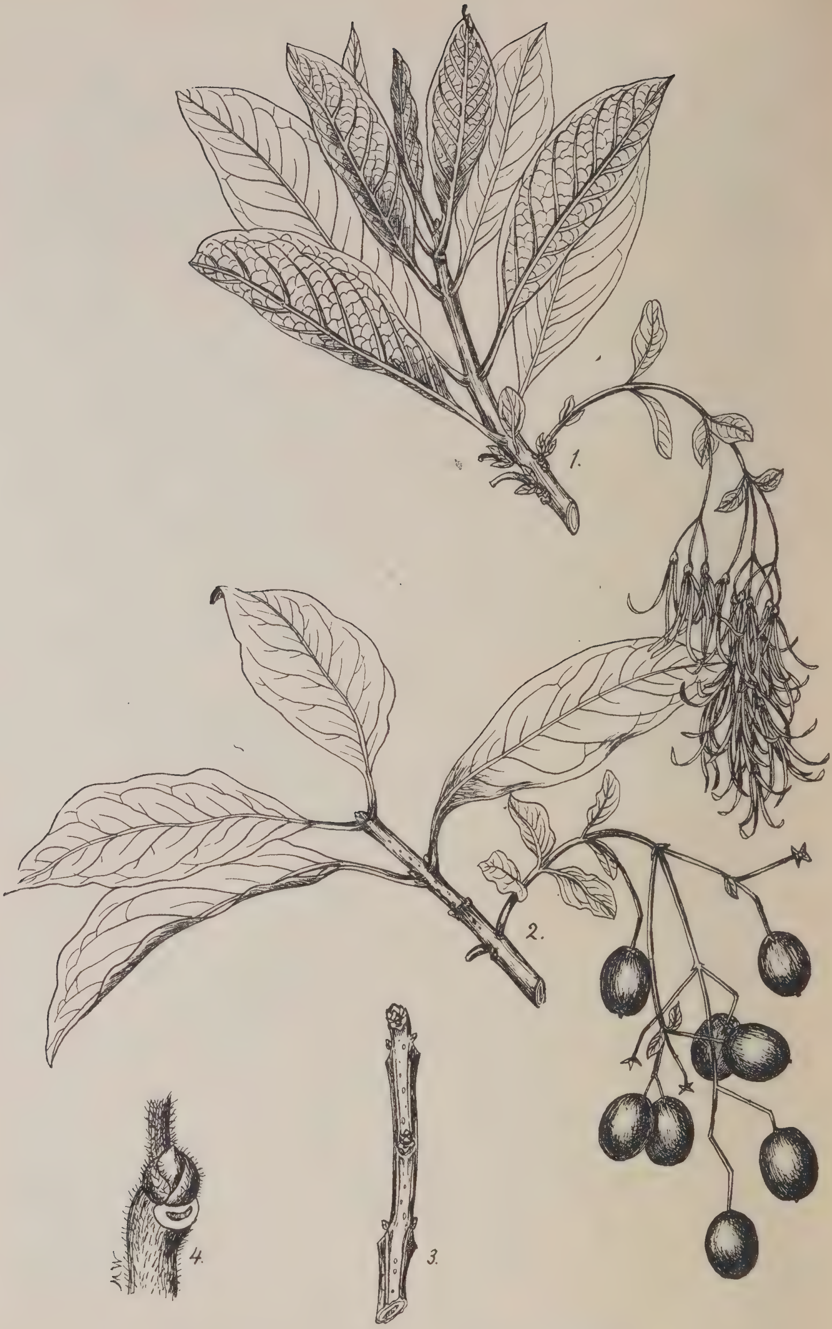

PLATE CXXVII. FRINGE-TREE

1. A flowering branch with immature leaves, x ½.
2. A fruiting branch with mature leaves, x ½.
3. A winter twig, x ½.
4. Section of a winter twig, natural size.

FRINGE-TREE

Chionanthus virginica, Linnaeus

GENUS DESCRIPTION—The genus to which the Fringe-tree belongs has only one other representative, the Chinese Fringe (Chionanthus retusa, Paxton), a native of eastern Asia. Both species are cultivated primarily for ornamental purposes. The generic name of these trees, Chionanthus, refers to the white flowers which resemble snow.

FORM—A slender, small-sized tree usually attaining a height of 20 ft. with a diameter of 6-8 inches, but may reach a height of 40 ft. with a diameter of 12 inches. Trunk usually short, bearing numerous, stout, and ascending branches which form a rather deep, narrow crown.

BARK—On main trunk rather thin, scaly, reddish-brown; on branches light brown to orange, and smooth.

TWIGS—Rather stout, light brown tinged with green, somewhat angled, slightly hairy. Marked by large, conspicuous and elevated leaf-scars and dark colored lenticels.

BUDS—Opposite, ovoid, sharp-pointed, about ⅛ of an inch long, covered with about 5 pairs of scales which increase in length from the outer towards the center, and are ciliated on the margin.

LEAVES—Simple, opposite, thickish, ovate, 4-8 inches long, 1-4 inches wide, wedge-shaped at base, entire on margin, acute at apex, dark green above, pale and smooth below except along the veins.

LEAF-SCARS—Opposite, raised, semi-circular in outline, upper side of margin partly surrounds bud; bundle-scars solitary, large, located on cushions.

FLOWERS—Appear in May or June when leaves are just developing. Borne in drooping panicles about 4-6 inches long; perfect, white, and slightly fragrant. The appearance of the snow white flowers resembles fringe, hence the common name Fringe-tree.

FRUIT—A berry, borne in loose clusters. Dark blue in color, about ½-¾ of an inch long, and surrounded at the base by a persistent calyx. Stalks bearing the fruit may bear leaf-like bracts. Skin of fruit usually thick and stones usually thin.

WOOD—Light brown in color, with rather wide and lighter colored sapwood; heavy, hard, close-grained. Weighs about 40 lbs. per cubic foot. It is put to no special commercial uses.

DISTINGUISHING CHARACTERISTICS—The Fringe-tree, also known as Old Man's Beard, White Fringe, American Fringe, Flowering Ash, and Snow Flower tree, is native to only a few counties in the southern part of the State. This limited distribution, together with its small size and its simple, opposite, entire-margined and thick leaves will enable one to distinguish it quite readily during the summer. The white fringe-like panicles of flowers will also assist during a limited portion of early summer. In winter, the opposite, rather stout branches bearing sharp-pointed, opposite buds covered with more than 4 pairs of scales, are also characteristic. The berry-like fruit combined with the opposite branch will distinguish this tree from practically all others found in the State.

RANGE—Southern New Jersey and southeastern Pennsylvania to Florida and Texas. It is essentially a southern species.

DISTRIBUTION IN PENNSYLVANIA—This tree is found locally in about 6 counties in the southeastern part of the State. It is nowhere abundant, nor does it attain large dimensions.

HABITAT—Usually found in rich, moist soil; also frequents banks of streams, lakes and swamps.

IMPORTANCE OF THE SPECIES—The Fringe-tree is planted extensively for ornamental purposes as far north as Massachusetts. Its beautiful flowers and its attractive form recommend it for planting in lawns and parks. The main objectionable feature is the fact that it retains its foliage for a relatively short period during the summer, since the leaves are late to appear and early to disappear. The poor quality and small size of the wood which it produces, together with its limited distribution and selective situations, do not recommend it for forestry purposes. It can readily be grafted upon our common species of Ashes. This enables one to develop it upon situations somewhat dry for the tree itself.

SWEET VIBURNUM

Viburnum Lentago, Linnaeus

FAMILY AND GENUS DESCRIPTION—The Honeysuckle family, Caprifoliaceae, is rather widely distributed in temperate regions. It comprises about 10 genera with 275 species of shrubs, trees, vines, and a few perennial herbs. About 8 genera are native to North America and 7 to Pennsylvania. The 7 genera native to this State comprise about 31 species, most of which are shrubs. The principal native genera are: The Elderberries (Sambucus), the Viburnums (Viburnum), the Bush Honeysuckles (Diervilla), the Honeysuckles (Lonicera) and the Snowberries (Symphoricarpos). Since most of the representatives of these genera are shrubs only a few have been discussed in this publication. A description of the others may be found in Gray's New Manual of Botany, or Porter's Flora of Pennsylvania. The Elders, belonging to the genus Sambucus, are among our best known shrubs. The Common Elderberry (Sambucus canadensis L.) is probably the best known. The flowers are conspicuous and sometimes used in making wine. The fruit is eaten and also made into wine, pies, and jellies. The Honeysuckles (Lonicera) are very common in our gardens and parks as ornamental shrubs and vines. They comprise about 100 species of which number at least 10 species are native to Pennsylvania. The Viburnums (Viburnum) also comprise about 100 species of which number about 20 species are native to North America and 11 to Pennsylvania. All of our species are usually shrubs, rarely small trees. The two species described on the following pages are occasionally found as small trees.

FORM—A shrub or small tree usually attaining a height of 10-15 ft., but may reach a height of 30 ft. with a diameter of 10 inches. Trunk usually short, bearing a round-topped crown formed by slender and usually drooping branches.

BARK—Disagreeable in odor, reddish, roughened in older specimens by division and subdivision into thick plates which are scaly on the surface.

TWIGS—At first greenish and covered with rusty hairs, later reddish to orange and rather smooth.

BUDS—Opposite, long, slender, scurfy, reddish-brown, covered by two rather rough scales. Lateral buds are usually leaf-buds and closely appressed to twigs. Terminal buds are often flower buds with a marked swelling at the base, and about ¾ of an inch long.

LEAVES—Opposite, simple, ovate, about 2½ inches long, sharp-pointed, narrowed or rounded at base, closely and very sharply serrate on margin, bright green, smooth on both upper and lower surfaces. Veins conspicuously connected by veinlets. Petioles often winged and grooved.

LEAF-SCARS—Opposite, wide, broadly U-shaped not encircling twigs, and usually with 3 bundle-scars.

FLOWERS—Small, perfect, white, appearing in May or June in dense, many-flowered, sessile, terminal cymes which are usually 3-5 inches broad.

FRUIT—A black or dark blue, fleshy, sweet, rather juicy drupe, containing a flat oval stone, and grouped into small clusters borne on slender, reddish, and often drooping stalks.

WOOD—Diffuse-porous; heavy, hard, dense, yellowish-brown, with very disagreeable and persistent odor. Weighs 46 lbs. per cubic foot. Not important commercially.

DISTINGUISHING CHARACTERISTICS—The Sweet Viburnum, also known as Sheepberry, Nannyberry, and Wild Raisin, resembles the Withe-rod or Wild Raisin (Viburnum cassinoides, L.) more closely than any other native Viburnum. The latter can be distinguished by its opaque or dull and obscurely-veined leaves with irregularly crenulate margins and by the peduncles which are usually shorter than the cymes. The Sweet Viburnum may attain a larger size than the Withe-rod and bears ovate leaves with closely and sharply serrate margins and winged petioles. Another closely related species is the Black Haw described on page 225, from which the Sweet Viburnum can be distinguished by its leaf-blades with acuminate apexes, its long-pointed reddish-brown buds, and its winged petioles. The Black Haw usually has blunt-pointed leaves, short-pointed and rusty pubescent buds, and no winged leaf-petioles. The lateral branches of the Black Haw are usually stiff and stand at right angles to the main stem, while those of the Sweet Viburnum are flexible and form an angle of about 45 degrees with the main stem. The Sweet Viburnum is usually found in wet locations while the Black Haw frequents dry situations and often forms almost impenetrable thickets along old fence rows. The long, slender, scurfy reddish-brown buds closely appressed to the clean, flexible, reddish-brown twigs are positive winter characteristics of the Sweet Viburnum.

RANGE—Quebec to Manitoba, south to Georgia, Indiana, and Missouri.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern, southern, and central parts of the State; local in the western part, and less frequent in the northern part.

HABITAT—Usually found along or near banks of streams and borders of lakes located in or near wooded areas.

IMPORTANCE OF THE SPECIES—The Sweet Viburnum has no commercial value, so far as wood production is concerned. Its form, flowers, fruit, and foliage make it one of the most attractive of our small ornamental trees.

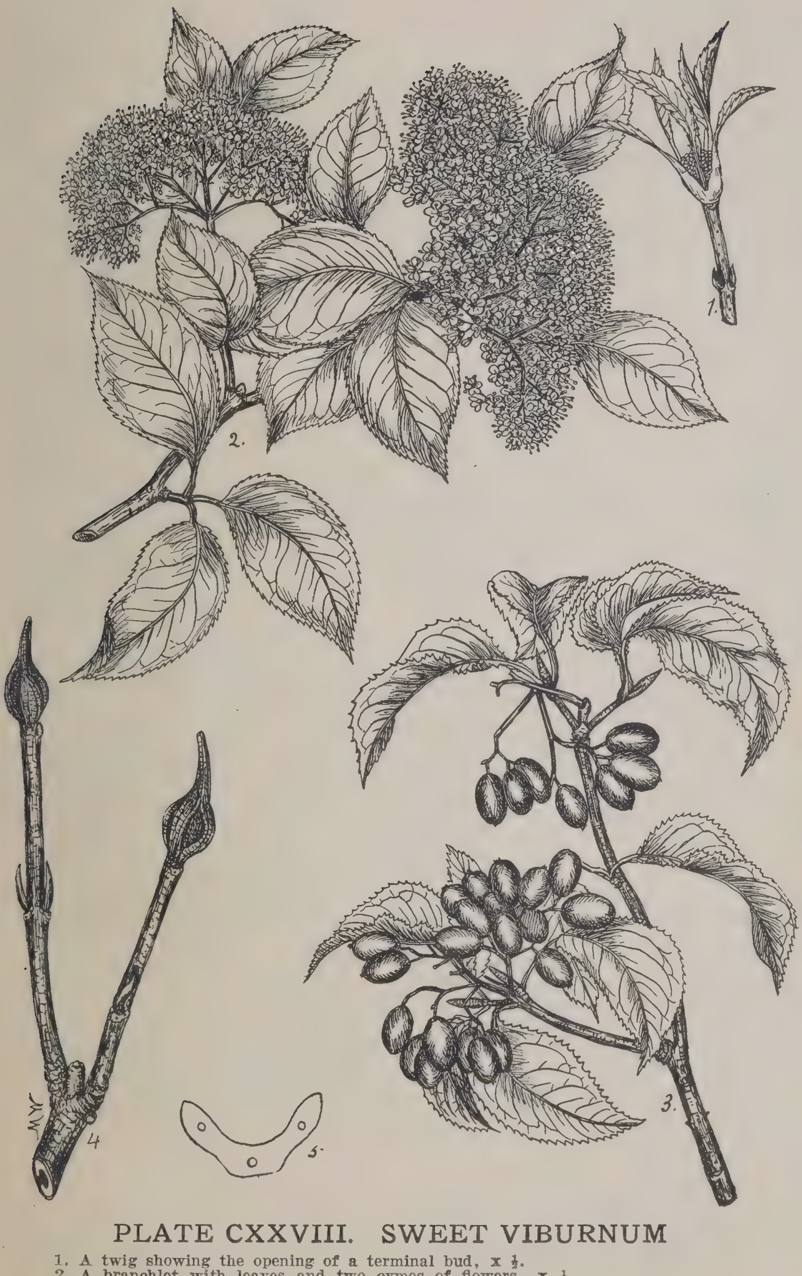

PLATE CXXVIII. SWEET VIBURNUM

1. A twig showing the opening of a terminal bud, x ½.
2. A branchlet with leaves and two cymes of flowers, x ½.
3. A branchlet with leaves and two clusters of fruit, x ½.
4. A winter twig with lateral leaf-buds and terminal flower buds, natural size.
5. A leaf-scar with three bundle-scars, enlarged.

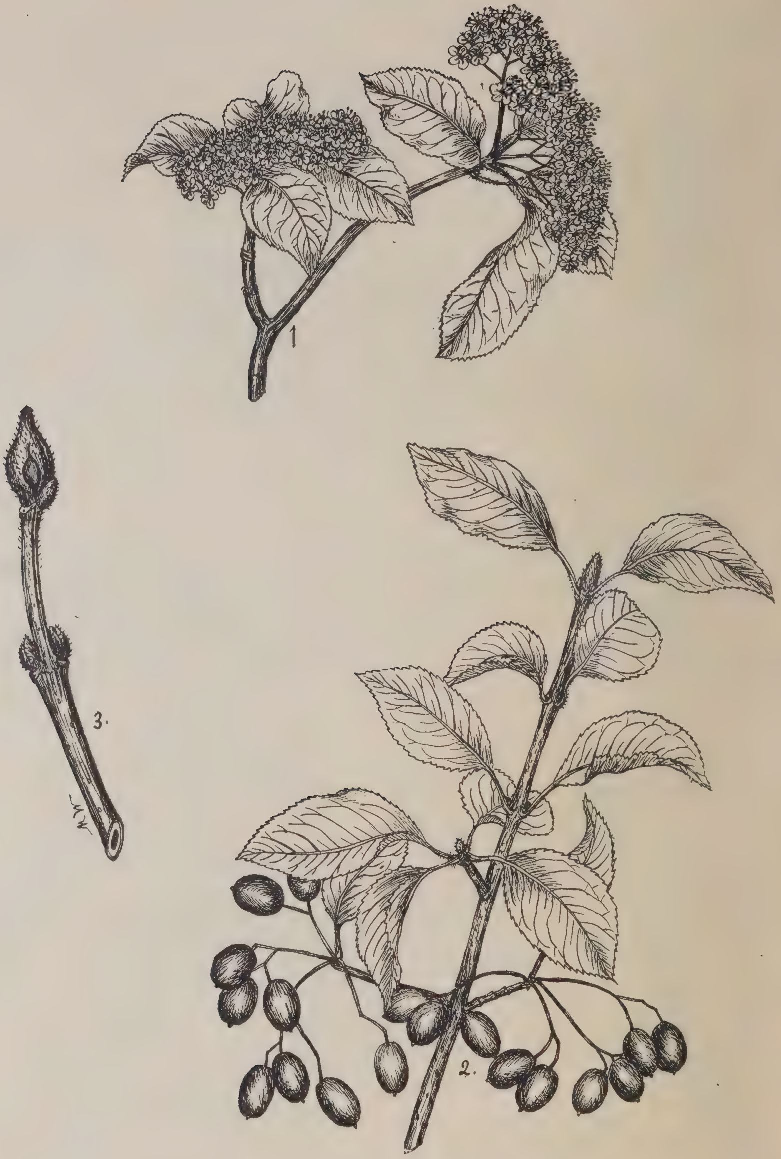

PLATE CXXIX. BLACK HAW

1. A branchlet with leaves and two cymes of flowers, x ½.
2. A branchlet with leaves and two clusters of fruit, x ½.
3. A winter twig with a large terminal flower bud and three leaf-buds. Two leaf-buds are opposite, and located about the middle of the twig, while the third is at the base and to right of the terminal flower bud, natural size.

BLACK HAW

Viburnum prunifolium, Linnaeus

FORM—A shrub or small tree usually attaining a height of 15 ft. but may reach a height of 35 ft. with a diameter of 10-12 inches. Trunk short, often crooked, bearing a rather broad and round-topped crown formed by stiff lateral branches.

BARK—About 2/5 of an inch thick, reddish-brown, rough, broken into thick plate-like scales.

TWIGS—At first reddish and smooth, then green, and later, during first winter, spine-like, gray tinged with red, and often covered with thin film-like bloom. Usually marked with orange-colored lenticels.

BUDS—Opposite, ¼-½ of an inch long, covered with 2 rusty pubescent scales which enlarge into leaf-like bodies in spring when growth begins. Axillary buds ¼ of an inch long, flattened, closely appressed to twig. Flower buds swollen near base.

LEAVES—Opposite, simple, oval, 1-3 inches long, obtuse or slightly pointed at apex, usually wedge-shaped at base, finely serrate on margin, sometimes leathery when old, dark green above and pale green below; petioles usually round, rarely winged.

LEAF-SCARS—See "Leaf-scars" under Sweet Viburnum.

FLOWERS—Small, perfect, white, appearing about May in dense, many-flowered sessile, and terminal cymes which are 3-4 inches broad.

FRUIT—Fleshy, dark blue drupe which is persistent, sweet and rather juicy; contains a flat oval stone; grouped in few-fruited clusters borne on reddish stalks.

WOOD—See "Wood" under Sweet Viburnum.

DISTINGUISHING CHARACTERISTICS—The Black Haw, also known as Sweet Haw, Sheepberry, Stag-bush, and Nanny-berry, closely resembles the Sweet Viburnum. See "Distinguishing Characteristics" under Sweet Viburnum. The Black Haw and the Sweet Viburnum may further be distinguished from the Maple-leaved Viburnum (Viburnum acerifolium) by the palmate venation of the leaf-blade and the small gaping buds of the latter, and from the Arrowwood (Viburnum dentatum) by the coarsely dentate leaves, the small gaping buds, and the evidently-stalked flower clusters of the latter.

RANGE—Connecticut, south to Georgia, and west to Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southern parts of the State, and local to sparse in the other parts.

HABITAT—Prefers dry rocky hillsides. Sometimes found in rather moist locations. Frequent along fences and roadsides where seeds may have been dropped by birds. Often forms almost impenetrable thickets along fences, especially when coppiced.

IMPORTANCE OF THE SPECIES—The Black Haw is of no commercial importance as a wood-producing tree, but for ornamental purposes deserves to be planted extensively. The bark of the roots is valuable medicinally.

GLOSSARY.

Abortion. Imperfect development or non-development of an organ.

Abortive. That which is brought forth prematurely, coming to naught before it is completed

Achene. A small, hard, dry, 1-celled, 1-seeded fruit which does not open by valves.

Acrid. Sharp or biting to the taste.

Acuminate. Decidedly tapering at the end.

Acute. Tapering at the end.

Aesthetic. Pertaining to the beautiful.

Afforesting. Turning ground into forest after being without a forest for a considerable length of time.

Alluvial. Relating to the deposits of sand, clay, or gravel made by river action.

Alternate. Not opposite to each other, but scattered singly along the axis.

Ament. A peculiar, scaly, unisexual spike.

Anther. The enlarged terminal part of a stamen which bears the pollen.

Apex. The tip or end of a bud or leaf, i. e. the part opposite the base.

Apical. Pertaining to the tip, end, or apex.

Appressed. Lying tight or close against.

Arborescent. Tree-like in appearance, size, and growth.

Aromatic. Fragrant; with a pleasing odor.

Astringent. Contracting; drawing together; building.

Axil. The upper angle formed by a leaf or branch with a stem.

Axillary. Situate in an axil.

Axis. The central line of an organ; a stem.

Bark. The outer covering of a trunk or branch.

Basal. Pertaning to or situate at base.

Berry. A fruit which is fleshy or pulpy throughout.

Bisexual. Having both stamens and pistils, i. e. male and female organs.

Bloom. A powdery or somewhat waxy substance easily rubbed off.

Bole. The body or stem of a tree.

Boreal. Pertaining to the north.

Bract. A modified leaf subtending a flower or belonging to an inflorescene.

Bud-scales. Modified leaves covering a bud.

Bundle-scars. Scars on the surface of a leaf-scar. Severed ends of the fibro-vascular bundles which connected the twigs with the leaves.

Calyx. The outer portion of a flower, usually green in color.

Cambial. Pertaining to the cambium.

Cambium. A thin-walled formative tissue between the bark and wood.

Capsule. A dry fruit composed of more than one carpel and splitting open at maturity.

Carpel. A simple pistil or one member of a compound pistil.

Catkin. An ament or spike of unisexual flowers.

Chambered. Said of the pith when interrupted by hollow spaces at rather regular intervals.

Ciliate. Fringed with hairs on the margin.

Coherent. Sticking together; connected.

Collateral. Accessory buds at the sides of axillary buds.

Complete. Said of flowers when all parts are present.

Compound. Composed of two or more similar parts united in a whole.

Concentric. Said of growth rings when the growth center coincides with the geometrical center.

Confluent. Flowing together; uniting. Said of the bundle-scars when the separate ones flow together and appear as one.

Conical. Cone-shaped.

Conifers. A group of trees which usually produce their fruit in the form of a cone.

Coniferous. Cone-bearing.

Conniving. Brought close together.

Contorted. Twisted together or back upon itself.

Convergent. Tending to one point.

Cordate. Heart-shaped.

Corolla. The inner portion of the perianth, composed of petals. The bright colored part of most flowers.

Corymb. A flat-topped or convex flower cluster, blooming first at the edges.

Corrugated. Shaped into grooves, folds, or wrinkles.

Crown. The upper mass of branches, also known as head.

Cyme. A flower cluster blooming from apex or middle first, usually somewhat flat.

Cymose. In a cyme; cyme-like.

Deciduous. Falling off, usually at the close of the season.

Decurrent. Extending down the stem below the insertion.

Defoliation. Removal of foliage.

Dehiscent. Splitting open.

Deliquescent. Said of the form of a tree with a broad spreading habit. The branches subdivide until they apparently disappear.

Deltoid. Delta-like, triangular.

Dentate. Toothed, usually with the teeth directed outwards.

Diffuse-porous. Equal-pored. Said of wood when pores in a growth ring are equal in size.

Digitately-compound. With the members arising at the same point at the end or top of the support.

Dioecious. Unisexual, with the two kinds of flowers on different plants.

Disseminated. Scattered; thrown broadcast.

Divergent. Pointing away; extending out. Said of buds which point away from the twigs.

Downy. Covered with fine hairs.

Drupe. A fleshy fruit with a pit or stone.

Eccentric. Not circular. Said of growth rings when growth center does not coincide with geometrical center.

Elongated. Long drawn out

Embryo. A young plant in a seed.

Entire-margined. Margin smooth, not cut or roughened.

Epidermis. The outer layer or covering of plants.

Equidistant. Equal distances apart.

Even-pinnate. With all the leaflets occurring in pairs.

Excurrent. Said of a tree with a continuous trunk and erect habit of growth.

Exfoliation. Splitting or cleaving off of outer layers of bark.

Exotic. Of foreign origin.

Exudation. Oozing out of sap, resin, or milk.

Fascicle. A cluster, usually dense.

Fertilization. The process by which pollen stimulates the ovule to produce a seed.

Fetid. Illsmelling.

Fibro-vascular bundles. The conducting strands which connect the leaves with the stem.

Fibrous. Consisting of fibers; woven in texture.

Filament. The stock bearing the anther.

Fissures. Grooves, furrows, or channels as in the bark.

Flora. The complete system of plants found in a given area.

Fluted. Grooved, corrugated, channeled.

Follicles. A dry fruit of one carpel, splitting on one side only.

Forestry. The rational treatment of woodlands for their products.

Fauit. A developing or ripened ovary. It may also include the axis containing the real fruit.

Fungus. A plant devoid of green color such as mushrooms and rots.

Gaping. With an open split at the end or apex.

Genus. A group of related species, as the pines or the oaks.

Glabrous. Smooth, without hairs.

Glandular. Bearing glands or gland-like.

Glaucous. Covered with a bluish or whitish waxy coating; a bloom.

Globose. Ball-like or nearly so.

Globular. Ball-like.

Habitat. The home of a plant.

Head. A dense cluster of sessile flowers or the crown of a tree.

Heartwood. The dead, central, usually highly colored portion of the trunk.

Herbaceous. Herb-like, soft.

Heterogeneous. Composed of dissimilar elements, as the wood of the hardwoods.

Homogeneous. Composed of closely resembling elements, as the wood of the conifers.

Imbricated. Overlapping like the shingles on a roof.

Incomplete. Said of flowers in which one of the outer parts is wanting.

Increment. Growth; increase.

Indehiscent. Applied to fruits that do not split open to let out the seeds.

Indigenous. Applied to plants that are native to a certain locality.

Inflorescence. The flowering part of a plant, and especially its arrangement.

Intolerant. Not shade enduring. Requiring sunlight.

Involucre. A circle of bracts surrounding a flower or cluster of flowers.

Irregular. Said of flowers showing inequality in the size, form, or union of similar parts.

Keeled. With a central ridge, like the keel of a boat.

Lamina. The blade or flattened portion of a leaf.

Lanceolate. Shaped like a lance; several times longer than wide.

Lateral. Situated on the side, as the buds along the side of the twig.

Leaflets. One of the small blades or divisions of a compound leaf.

Leaf-scar. The scar left by the falling of a leaf.

Lenticel. A corky growth on young or sometimes older bark, which admits air to the interior of the twig or branch.

Linear. Line-like, long and narrow, with parallel edges.

Lobed. Said of leaves that have the margins more or less cut or divided.

Lunate. Of the shape of a half-moon or crescent.

Manna. A sweetish secretion used in medicine as a mild laxative.

Medullary. Pertaining to the pith or medulla.

Medullary Ray. Radial lines of tissues crossing the growth of rings at right angles and extending into the bark.

Midrib. The central or main rib or vein of a leaf.

Mongrel. Composed of two elements of entirely different origin.

Monoecious. Bearing stamens and pistils in separate flowers on the same plant.
Morphological. Pertaining to the form and structure of plants.
Mucilaginous. Shiny, or gummy when chewed.
Naked. Said of buds without scales and seeds without a covering.
Naval Stores. Refers to tar, turpentine, resin, etc.
Nerve. One of the lines or veins running through a leaf.
Node. A place on a twig where one or more leaves originate.
Non-porous. Without pores.
Nut. A dry, 1-seeded, indehiscent fruit with a hard covering.
Nutlet. A small nut.
Ob-. A prefix meaning inverted or reversed.
Oblique. Slanting, uneven.
Oblong. About twice as long as wide, the sides nearly parallel.
Obovate. Reversed egg-shaped.
Obtuse. Blunt.
Odd-pinnate. With an odd or unpaired leaflet at the tip of the compound leaf.
Opposite. Said of leaves and buds, directly across from each other.
Orbicular. Circular.
Ovary. The part of the pistil producing the seed.
Ovate. Egg-shaped.
Ovoid. Egg-shaped or nearly so.
Ovule. The body which after fertilization becomes the seed.
Palmate. Hand-shaped; radiately divided.
Panicle. A compound flower cluster, the lower branches of which are longest and bloom first.
Parasite. Growing upon and obtaining its nourishment from some other plant.
Parenchyma. A class of plant tissue found in the green layers of the bark, in wood and pith
Pedicel. The stalk of a single flower.
Peduncle. The stalk of a flower cluster or of a solitary flower.
Pendulous. Hanging.
Perennial. Lasting for more than one year.
Perfect. A flower with both stamens and pistils.
Perianth. A term applied to the calyx and carrolla taken together.
Persistent. Remaining after blooming, fruiting, or maturing.
Petals. A part of a corolla, usually colored.
Petiole. The stalk of a leaf.
Pinna. A division, part, or leaflet of a pinnate leaf.
Pinnate. With leaflets on both sides of a stalk.
Pistil. The central part of the flower containing the prospective seed.
Pistillate. Bearing pistils but no stamens.
Pith. The soft central part of a twig.
Pod. Any dry and dehiscent fruit.
Pollen. The dust-like substance found in the anthers of a flower.
Pollination. The process of bringing the pollen of the male flower in contact with the stigma of the female flower.
Polygamous. Producing staminate, pistillate and perfect flowers all on the same plant.
Pome. A fleshy fruit with a core, such as the apple.
Prickle. A sharp-pointed, needle-like outgrowth.
Profligate. Wasteful, extravagant.
Propagate. Said of buds containing reproductive organs.
Pseudo—. A prefix meaning false, not true.
Pubescent. Hairy.
Pungent. Ending in a sharp point: acrid.
Pyramidal. Shaped like a pyramid with the broadest part near the base.
Raceme. A simple inflorescence of flowers borne on pedicels of equal length and arranged on a common, elongated axis.
Rachis. The elongates axis of an inflorescence, as a raceme.
Ray. See *Medullary ray.*
Reflexed. Abruptly turned backward or downward.
Reforestation. The process of putting a forest growth upon an area which had its forest growth removed recently.
Regular. Said of flowers which are uniform in shape or structure.
Resin-ducts. A passage for the conduction of resin found in the leaves and wood.
Ring-porous. Said of wood which has pores of unequal size, the larger ones being found in the spring wood and the smaller in the summer wood.
Rugose. Wrinkled.
Rugosities. Projections, wrinkles, knobs.
Saccharine. Pertaining to or having the qualities of sugar.
Samara. An indehiscent winged fruit.
Sapwood. The recently formed, usually light wood, lying outside of the heartwood.
Scales. The small, modified leaves which protect the growing-point of a bud or the part of a cone which bears the seeds. The small flakes into which the outer bark of a tree divides.
Scurfy. Covered with small bran-like scales.
Sepal. One of the parts of the calyx.

Serrate. Having sharp teeth pointing forward.

Sessile. Seated; without a stalk.

Sheath. A tubular envelope or covering.

Shrub. A low woody growth which usually branches near the base.

Silky. Covered with soft, straight, fine hairs.

Simple. Consisting of one part, not compound.

Sinus. The cleft or opening between two lobes.

Species. A group of like individuals as Red Oak, White Oak, etc.

Spike. An elongated axis bearing sessile flowers.

Spile. A small peg or wooden pin. Sometimes synonymous with pile.

Spine. A sharp woody outgrowth.

Stamen. The part of a flower which bears the pollen.

Staminate. Said of flowers which bear only stamens. Sometimes spoken of as male.

Sterigmata. The projections from twigs bearing leaves.

Sterile. Barren; unproductive.

Stigma. The end of a pistil through which pollination takes place.

Stipule. A leaf-appendage at the base of the leaf-stalk.

Stipule-scar. The scar left by the fall of the stipule.

Stoma. (plural *stomata*) An opening in the epidermis of a leaf communicating with the internal air cavities.

Striate. Marked with fine elongated ridges or lines.

Striations. Long narrow lines or ridges.

Strobile. A fruit marked by overlapping scales as in the Pine, Birches, etc.

Style. The pin-like portion of the pistil bearing the stigma.

Sub-. A prefix meaning under or nearly.

Sucker. A shoot arising from an underground bud.

Superposed. Said of buds when they are arranged one above the other.

Symmetrical. Regular as to the number of parts. Having the same number of parts in each circle.

Terminal. Pertaining to buds located at the end of twigs.

Thorn. A stiff, woody, sharp-pointed projection.

Tolerant. Applied to trees which endure certain factors, particularly shade.

Tomentum. A dense layer of hairs.

Tomentose. Densely pubescent; hairy.

Truncate. Ending abruptly, as if cut off at the end.

Tubercle. A small tuber or tuber-like body.

Tufted. Growing in clusters.

Umbel. A flower-cluster with all the pedicels arising from the same point.

Unisexual. Consisting of one sex only, either staminate or pistillate.

Valvate. Said of buds in which the scales merely meet without overlapping.

Vegetative. Said of buds which do not contain reproductive organs.

Veins. Threads of fibro-vascular tissue in leaves or other organs.

Versatile. Used for many purposes.

Viscid. Glutinous; sticky.

Whorl. A group or three or more similar organs, as leaves or buds, arranged about the same place of attachment.

Whorled. Borne in a whorl.

Xylology. The science which treats of the form and structure of wood.

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